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THE Petroleum Engineer

JULY 1938

VOLUME IX NUMBER 11

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MEETINGS

California Natural Gasoline Association—August 4, Richfield Building, Los Angeles, California.

West Virginia Oil and Natural Gas Association—July 27 and 28, Charleston, West Virginia.

American Chemical Society—September 5, 6, 7, 8, and 9, Milwaukee, Wisconsin.

American Association of Petroleum Geologists, Mid-Year Meeting—September 27, 28, 29, 30, October 1, and 2, El Paso, Texas.

Society of Automotive Engineers, National Regional Fuels and Lubricants Meeting—October 6 and 7, Tulsa, Oklahoma.

American Institute of Mining and Metallurgical Engineers, Petroleum Division—October 6 and 7, San Antonio, Texas.

American Gas Association—October 10, 11, 12, 13, and 14, Atlantic City, New Jersey.

National Stripper Well Association, Annual Meeting—October 18, Tulsa, Oklahoma.

Oklahoma Stripper Well Association, Annual Meeting — October 18, Tulsa, Oklahoma.

Independent Petroleum Association of America—October 19, 20, and 21, Tulsa, Oklahoma.

Mid-Continent Oil and Gas Association, Texas Division—October 27, 28, and 29, San Antonio, Texas.

American Petroleum Institute, 19th Annual Meeting—November 14, 15, 16, 17, and 18, Stevens Hotel, Chicago, Illinois.

American Society of Mechanical Engineers—December 4, 5, 6, 7, 8, and 9, Philadelphia, Pennsylvania.

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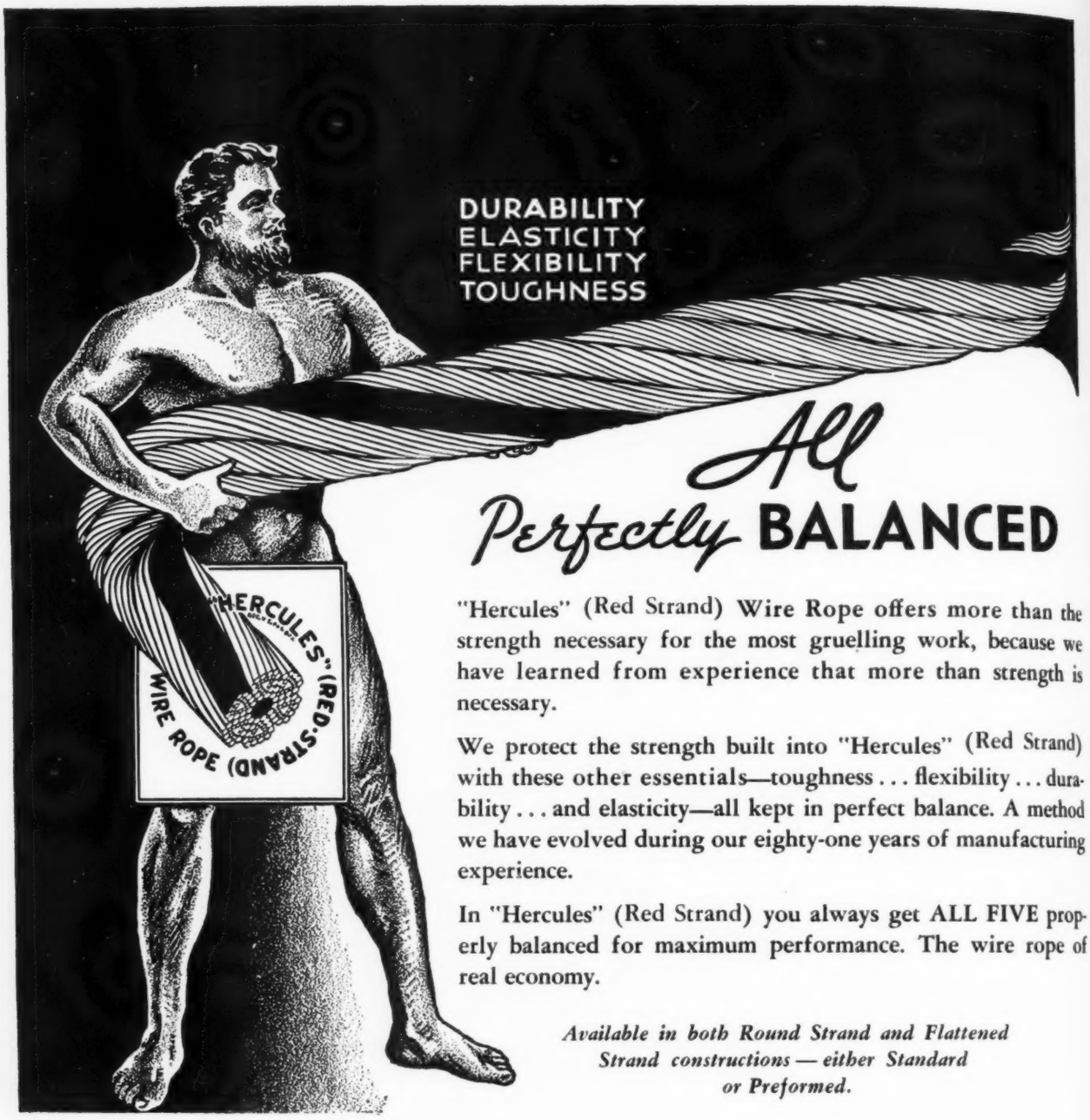

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The Course of Oil

By K. C. SCLATER

Research and Practice It has been brought to the attention of this department that "Not only in engineering, but in the entire field of research the lag that exists between the findings of the research laboratory and getting those findings into everyday use is one of the greatest ills confronting progress.

"'A Challenge—Shorten the Lag Between Research and Practice,' an address by Frank T. Sheets, president of the Portland Cement Association, at the 34th Annual Dinner of the American Concrete Institute, analyzes this important subject for the engineering profession and suggests a solution that may be helpful in making the findings of all research more quickly used in practice."

As research plays an important part in the advancement of the petroleum industry the "challenge" referred to and the solutions suggested therein are of particular interest.

One of the greatest ills of the engineering profession is the long lag between research and practice—the time elapsing between the discoveries and findings of research and their general acceptance and application by engineering practitioners.

The primary cause of this ill is lack of interpretation and lack of selling of the fruits of research.

If we make a painstaking survey of current engineering practice, we are forced to admit that it lags away behind the knowledge which has been developed from research and scientific analysis. This applies generally throughout the entire field. Examples occur in the road field, in the structural field, and in many others. Building codes, for examples, frequently prescribe narrow limits, within which the practitioner must prepare his designs, and yet many building codes are obsolete in the light of present day knowledge.

Before we can expect the findings of research to be adopted and made a part of current engineering practice, it is necessary that they be understood, absorbed, and molded into a form usable by the practitioner. Therefore, in taking up the challenge to shorten the lag between research and practice, it is reasonable that we look at the practitioners and see what manner of men comprise this group. Among them we find:

1. Busy executives, scientifically inclined, open-minded, but too busy to delve into research details;
2. Busy executives, non-scientific in instinct, impatient of detail and given to direct action;
3. The closed-minded individuals, self-sufficient in their own knowledge, who are inclined to pooh-pooh any proposition, with which they are not acquainted, as abstract theory;
4. The so-called practical engineers, scoffing at any problem involving more than arithmetic and simple equations;
5. The know-it-alls;
6. The do-it-the-way-we-learned-in-school crowd;
7. The copy cat, tradition-loving, mentally lazy flock;
8. The very, very few who are just plain dumb;
9. The smart, open-minded searchers for better things.

To this composite and widely varying crew, the fruits of research must be interpreted and sold.

As we approach the problem of interpreting and selling the fruits of research to the practitioner, it might be well to pause and consider—what is research? To my mind, it may be best defined as the honest, intelligent, painstaking search for useful truth. As such, it exists for the good it produces; and any activity carried on as mental gymnastics, for entertainment and pleasure alone, or for the personal aggrandizement of individuals, does not come within this definition, and cannot be dignified by the name research. In its higher sense, research is a sacred trust. It must be entrusted to those high-minded, self-sacrificing, conscientious individuals who will regard it as such, and who will realize their responsibility to their fellow members of the engineering profession.

We have already discussed the complex group called practitioners. It is equally pertinent to take the researchers apart and see who they are. As we do so, we find that the researchers are made up of:

1. Inhabitants of the technical stratosphere—men who think so deeply in their particular field that rather complicated statements seem simple to them, and who are not conscious of being profound—"who could not if they would," talk the language of the practitioner;
2. Cloud riders—not quite so abstract or profound in their thinking and utterances as the stratospherists, but still difficult for the practitioner to follow;
3. Technical adventurers, engaging in research mainly for the fun of it, largely indifferent to responsibility of interpreting results and completing investigations, and constantly looking for new fields to conquer;
4. The technical snobs—thank heaven they are few—who like to talk a ten cent idea in ten dollar language, thus impressing the uninformed with their profound minds;
5. The self-advertisers, thinking of research primarily as a ladder to personal success;
6. The conscientious thinkers;
7. The unselfish servers of fellow engineers;
8. The rare species, who simultaneously contribute unselfishly, think deeply, conclude soundly, talk simply.

With these complex and violent contrasts in the personnel composing the groups of researchers and practitioners, it is no wonder that there is a lag between research and practice, and that a studied effort must be made by both groups to facilitate molding research into practice.

With this problem before us, a good dose of frank self-analysis will be most helpful. There is a lot of good and a little of bad in each of us. Let us strive to eliminate the faults that are keeping researchers and practitioners so far apart, and let each individual in the two groups tune his thinking and his actions to the obvious needs of his fellow engineers.

These preliminary discussions bring us to a consideration of research reports as they are prepared today. Generally speaking, they are written primarily for the consumption of researchers, rather than practitioners.

They frequently require the reader of the report to know as much about the research problem and the work as the writer himself, in order to gain a clear understanding of what the writer really means. They are not directed at the ultimate consumer.

The make-up commonly used consists of: a statement of the problem; a description of the apparatus; discussions of the details of the methods of making tests and measurements; a complete presentation of the data secured; a summary of the findings; the conclusions.

The sad part is that frequently these component parts of research reports are badly jumbled together in writing, so that it is difficult for the uninformed or busy reader to segregate the information in which he is primarily interested.

Obviously, fellow researchers want all of these component parts of a research report to be clearly and separately stated, but the practitioner (believing in the researcher's integrity and ability) wants primarily: a statement of the problem; a presentation of essential findings of fact; the conclusions from the facts, stated in such a way that they may be applied to practice.

Therefore I present this question: 'Why not write all research reports from the practitioners' point of view?' This would mean incorporating in the body of the report a statement of the problem, the essential findings of fact and conclusions for embodiment in practice—putting in an appendix or supplement the other information which follow researchers would find interesting and helpful in analyzing the researcher's report, such as: a description of the apparatus; the details of tests and measurements; the data secured. It might be best in many instances not to publish such a supplement as a part of the report, but merely to refer to it as being available, on request, to those who require such supporting detail.

This course is suggested, not with the idea that it is not absolutely essential to record permanently and state clearly information of the type which would be included in a supplement of this character; but rather to emphasize that part of the research report which is essential for the practitioner, to strip research reports down to these bare essentials and thus to challenge the busy practitioner to read and apply useful truth.

However, in spite of the benefits which would follow such reforms in report writing, the fact remains that in many cases after the researcher has gone as far as he can toward grasping the need of the practitioner and presenting his findings from that point of view, and after the practitioner has gone as far as he can in entering the realm of the researcher, there still remains a 'No-Man's-Land,' a missing link between research and practice. In such case, we badly need an interpreter.

This would be an engineer who is fully competent, from the standpoint of training and mental capacity, to grasp the findings of the researcher, and who at the same time has a background of practice and a knowledge of the practitioner's needs. This ability would enable him to analyze and assimilate the researcher's findings and state them in language which the average practitioner can comprehend.

An alternative would be a joint committee of researchers and practitioners, who will review a research report before its release, to insure that the statements are not only sound from the research point of view but understandable and in form for application by the practitioner.

An outstandingly good example of the type of interpretation we have in mind consists of the textbook writers and engineering teachers. Here we have men who are forced frequently to take complicated technical information, obtained through profound research, and interpret it in such a way that it may be grasped by young engineering students, the average of whom have no higher mental qualifications than the average of the practitioners, and who lack the background of experience which the practitioner has.

All researchers and practitioners were once engineering students, and none of us can fail to remember how we blessed the outstanding textbook writers and outstanding teachers, who presented their material understandably. If we had not had good interpreters in our younger student days, many of us would not be engineers now, and with this fine record of the fruits of good interpretation, it seems distressing that we have not more generously employed the interpreter in our more mature technical experience to keep practice abreast of research.

In our civic experience whenever we encounter a distressing condition, the first cry is for legislative reform. And so, as I contemplate this problem, I am tempted to say 'There ought to be a law' providing that

1. All researchers must try to determine what the problem is before they start to solve it;
2. All researchers must analyze results and prepare an understandable report on completed projects before new ones can be started;
3. All the profound shall try to be simple, and the simple to be profound;
4. A practitioner shall be outlawed if he doesn't keep up with research and apply it;
5. The researcher shall be ostracized by his fellows if he forgets the need of the practitioner or indulges in technical snobbery;
6. Interpreters shall be born, trained, used and honored;
7. All must search for, recognize and apply scientific truth;
8. All researchers must recognize that the intelligence quotient rating of practitioners as a body is probably reasonably near that of the researchers as a body; that merely because the practitioners haven't time to be as familiar with research as the researchers, and are too busy to delve into involved, verbose and abstract reports, they are not dumb; and that the practitioner is too busy being a practitioner to be necessarily a good researcher.

« « HIGHLIGHTS IN OILDOM » »

Robertson Law in Effect

The Robertson bill to regulate the production of oil in state-owned tideland oil fields of California is now in effect. An attempt to take it before voters in November on a referendum failed because its opponents failed to obtain the necessary signatures.

The new law provides for a commission composed of the state controller, the lieutenant-governor, and the director of finance, which will lease the lands and determine the royalty the state will obtain.

The Robertson law reserves to the state all oil, gas, oil shale, coal, phosphate, gold, silver, and other mineral deposits in the tidelands. These deposits can be disposed of only on a rental or royalty basis. Sole authority to issue prospecting permits and sign royalty contracts for the state of California is vested in the new commission.

●

Three Illinois Oil Bills Introduced

Three bills designed to regulate and tax the oil industry have been introduced in the Illinois legislature. One of the measures would impose a 2½ percent severance tax on all oil and gas production. The other two bills are concerned with giving the Illinois Commerce Commission authority to draw up regulations for the control of oil and gas production in the interest of conservation.

●

California Moves To Curb Gas Wastage

The California Division of Oil and Gas has taken steps to curb excessive production of gas in the state. The first step in the program was the meeting on June 28th of operators of the Dominguez field, who agreed to work out a plan to prevent future wastage of gas. Howard Pyle was named chairman of the operators' committee to work with state officials to establish a new ratio in several fields that have been exceeding their gas quota. To bring this about a number of other meetings were arranged.

This series of meetings was the outgrowth of a mass meeting called previously by Governor Merriam to bring the matter of gas wastage to a head. At that time he impressed upon operators that a reduction in gas waste must be forthcoming or drastic steps would be taken to enforce the state's gas act.

●

Pennsylvania Crude Prices Again Reduced

The latest reduction in prices for Pennsylvania grade crude oil was 25 cents a barrel. This is the fifth price reduction since September 1, 1937. Companies announcing the new quotations were the Seep Purchasing Agency of the South Penn Oil Company, Pennzoil Company, Cities Service Company, Valvoline Pipe Line Company, and the Pure Oil Company.

The new quotations are as follows:

Bradford-Allegany district, $1.80 a bbl.; Oil City-Titusville district, $1.73 a bbl.; Group A, including Cochran, Franklin, Hamilton, and Doolittle districts, $1.73 a bbl.; Group B, Titusville district, $1.72 a bbl.; Group C, including Turkey and Tidioute districts, $1.71 a bbl.; Group D, including Bear Creek and Porkey districts, $1.70 a bbl.; Group E, including Eideneau, Bull Creek, Rough Run, Carbon, Dipner, Bredin, McJunkin, Jameson, Kennerdell, Emlenton, Tiona, Lack, and Kinzua districts, $1.68 a bbl.; Southwest Pennsylvania, $1.46 a bbl.; Eureka lines and West Virginia stations of Pure Oil Company, $1.40 a bbl.; and Buckeye lines, $1.30 a barrel. A few days after this general price reduction Corning grade crude price was cut to $1.17 a barrel.

●

Texas Abolishes Saturday Shutdown

In its latest proration order, that effective July 1st, the Texas Railroad Commission abolished Saturday shutdowns for the state although retaining the Sunday closings. It had been proposed that both Saturday and Sunday shutdowns should be abolished, but the protest of operators prevailed.

In announcing the Railroad Commission's decision, Commission Chairman Terrell said:

"Favorable trends developing in recent weeks continue to reflect improved conditions in the oil industry. Strict production control policies, and reduced refinery runs, are doing much to bring the supply of crude oil and gasoline more nearly in line with demand.

"Crude stocks have been reduced to a point where they are now three percent lower than at this time last year, and gasoline stocks declined 1,700,000 bbl. during the week ending June 18, 1938.

"We are now entering a period of high gasoline consumption, which should further reduce excessive stocks and contribute to additional improvement in the oil industry's position during the next few months. There are also important signs that business recovery may be taking place, and should this be true the trend of a decreasing domestic gasoline consumption will probably be reversed."

●

Kansas May Revise Oil Regulation Plan

Kansas' new oil proration regulations, adopted less than a year ago, may be revised at a hearing of the Corporation Commission announced for this month. The commission, in announcing the hearing, said evidence would be received for the "revision, modification, repeal or amendment of present rules and regulations concerning the production, sale, and conservation of crude oil, and the establishment of potentials for oil wells."

The regulations, including the withdrawal decline curve method of fixing oil-well potentials by calculation instead of physical tests, were adopted in July, 1937. An order by the commission last April extended from nine to 12 months the period for physical tests on wells operating on the curve method. Potentials fixed for wells in June were ordered by the commission to continue in force until otherwise ordered.

●

Oklahoma Marginal Well Rule Attacked

The Grison Oil Company has attacked in the Oklahoma Supreme Court as "unfair" a Corporation Commission order setting marginal allowables in the Wilcox zone of the Oklahoma City field at 165 bbl. per day.

The complainant says the order favors small wells and discriminates against large wells and asks a writ of prohibition to hold up application of the order, which went into effect July 1st.

The order provides that each well in the zone may produce 165 bbl. of oil a day, or its full production if incapable of producing that amount.

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Progress of Major Pipe Line Work

RUMORS, current for several weeks, to the effect that the Continental Oil Company would lay a pipe line from the Lance Creek field, Niobrara County, Wyoming, to Denver, Colorado, have finally been confirmed. W. H. Ferguson, executive vice-president of the company, has stated definitely that a 245-mile, 6-in. line will be constructed starting this month. Application for permission to lay the line was made in the name of the Celibur Corporation and for some time it was denied that Continental was in any way connected with the project.

The line will be constructed of seamless pipe, welded at the joints. Its capacity will be 10,000 bbl. per day. The project is expected to cost $2,000,000.

The Continental Oil Company has 41 percent of the acreage in the Sundance participating area at Lance Creek, and about 4000 acres outside the participating and unit areas, including a large block of acreage covering the east Lance Creek high. Under the unit plan Continental receives about 4500 bbl. of Sundance oil per day.

At Denver, Continental operates a refinery having a distillation capacity of 1850 bbl. per day and a cracking capacity of 1000 barrels. This plant will be served by the new pipe line, and it is also quite likely that the Bay Petroleum Corporation, which has a 1650-bbl. refinery at Denver, will receive at least a part of its crude from this source. At present this refinery is purchasing about 1500 bbl. of Lance Creek crude per day.

Upon the completion of the new line the Continental Oil Company will take up its present line from the Lance Creek field to Manville, at which point crude is loaded into tank cars for shipment.

The Lance Creek field has one other outlet at this time. The Illinois Pipe Line Company operates a line from the field south 24 miles to the Fort Laramie station on the Stanolind Pipe Line Company's system to Freeman, Missouri. This line transports 5000 bbl. of crude per day from the field to Fort Laramie where it is mixed with stored Salt Creek oil and moved to mid-western refineries of the Standard Oil Company of Indiana.

●

The Shell Petroleum Corporation's gasoline pipe line from its Wood River, Illinois, refinery to Lima, Ohio, is being completed. At the latter point it will connect with the gasoline pipe line system of the Standard Oil Company of Ohio, making it possible for Shell to reach by pipe line delivery points as far north as Toledo, Ohio, and the Great Lakes.

Terminals are being provided at Zionsville, Indiana; Effingham, Illinois; Terre Haute, Indiana; Muncie, Indiana, and Springfield, Ohio. Field headquarters will be at Zionsville, a suburb of Indianapolis.

Officials of the new pipe line system were named recently. R. B. High is manager and S. S. Smith general superintendent. Both will have their offices in St. Louis. W. H. Shelley, formerly superintendent of the company's Illinois division, has been appointed field superintendent. M. E. Overman has been named chief dispatcher, J. H. Hall chief electrician, and R. F. Ballman chief accountant. Superintendents of the terminals include C. R. Schulthies, F. D. Miller, and J. R. Rodger, all from the company's refinery at Arkansas City, Kansas, and F. R. Chase, formerly chief engineer of the Braman, Oklahoma, gasoline plant.

●

A 6-in. oil line will be laid by the Standard Oil Company of Louisiana from the Magnolia field, Columbia County, Arkansas, to the company's trunk line at Haynesville, Louisiana, a distance of 25 miles, it has been announced. In addition, the company will lay about 15 miles of gathering lines in the Magnolia field to serve that newly-developed area.

●

The Derby Oil Company has awarded a contract to the Pipe Line Service Company, Seminole, Oklahoma, for the laying of a 4-in. pipe line from the company's pump station in the Robbins pool, Kansas, south of Wichita, to the Wellington pool, Sumner County, a distance of 20 miles. The Derby Oil Company recently contracted with E. B. Shawver, independent operator, and the Transwestern Oil Company to run oil from their leases in the Wellington area. Until the pipe line is completed the crude will be shipped to Wichita by tank car.

●

The Oklahoma Natural Gas Company is laying 15 miles of 12-in. pipe line near Cement, Oklahoma. The pipe was taken up at Mildred, Kansas, by E. M. Campbell and Company and is being laid by the White Deer Pipe Line Construction Company.

●

Six miles of 12-in. pipe and one mile of 14-in. pipe are being laid through the city of Hammond, Indiana, by the Sheehan Pipe Line Construction Company for the Stanolind Pipe Line Company.

●

Sinclair Refining Company, Pipe Line Division, is laying a 12-mile, 4-in. pipe line from the Sinclair Prairie Oil Company's No. 1 J. M. Best well in the new deep-producing area of northeastern Cooke County, Texas, to a loading rack at Gainesville.

●

The Michigan Public Utilities Commission has been petitioned by the Commonwealth Pipe Line Company for permission to construct several pipe lines to serve Allegan County fields. One line would connect the company's truck-loading racks in Dorr, Monterey, and Salem townships with the Dorr field. This line also would extend to a truck-loading rack in Hopkins Township and a tank-car loading rack at the same point. Another line would extend from truck-loading racks and storage plants in Salem Township to Muskegon, and a third from Salem Township to Vriesland, Ottawa County, where it would connect with truck-loading facilities.

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Latest Activities In The Oil Fields

CUNNINGHAM Oil Company's No. 1 Union Pacific-Cronberg, on the Oil Springs structure in the Laramie Basin, Wyoming, and six miles north of the Allen Lake gas field, produced 55,000,000 cu. ft. of gas per day from Sundance sand at a depth of 2232 feet. Total depth of the well is 2315 feet. Pressure on the casing was 1100 pounds. This is one of the largest gas wells completed in Wyoming in recent years.

●

Humble Oil and Refining Company and Gulf Oil Corporation's No. 1 Robertson, southwest of Longview, Gregg County, Texas, flowed 26 bbl. of distillate and 5,000,000 cu. ft. of gas per day at a tubing pressure of 500 lb. through perforations at a depth of 7244 to 7286 feet. Production is obtained from the Glen Rose lime.

●

Magnolia Petroleum Company's No. 1 Ferguson, in 5-12s-2w, Vermilion Parish, Louisiana, on the West Gueydan prospect, flowed 85 bbl. of distillate and 1,900,000 cu. ft. of gas in 24 hours through 16/64-in. choke from a depth of 7130 feet. The well was plugged-back from 9144 feet.

●

Helmerich and Payne et al's No. 1 State School Land, in SW SE SW 16-28-1w, Kay County, Oklahoma, midway between the Braman and Blackwell pools, produced at the estimated rate of 300 bbl. per day from the second Wilcox at a depth of 3620 feet. Total depth of the well is 3645 feet. The 6⅝-in. casing was set at 2900 ft. and a 4½-in. oil string was set.

●

Rhodes and Tompkins' No. 1 Emma Cowden, in section 1, block 44, T-2-S, T. & P. Survey, Andrews County, Texas, after stage treatment with 1500 and 5000 gal. of acid, flowed at the rate of 40 bbl. of oil per hour from a total depth of 4220 feet.

Continental Oil Company's No. 1 James Moss, in 8-10-9w, Calcasieu Parish, Louisiana, in the Lockport sector near Lake Charles, flowed 138 bbl. of oil in 24 hours through ⅛-in. choke at a tubing pressure of 700 lb. and a casing pressure of 500 pounds. The well was drilled to a depth of 6737 ft. and plugged-back to 5340 ft. and 6-in. casing perforated between 5314 and 5324 feet.

●

Devonian Oil Company's No. 1-C-8 Duggan, labor 8, league 54, Oldham County School Lands, Cochran County, Texas, after treatment with 2000 gal. of acid flowed 107 bbl. of oil in 20 hours. This well is two miles south of the previous limit of the Duggan field.

●

Petroleum Producers Company and Continental Oil Company's No. 1 State Asylum Land, in SW corner, block 1, Cherokee County School Land, Wichita County, Texas, after treatment with 3000 gal. of acid flowed at a rate estimated at 500 bbl. of oil and 500,000 cu. ft. of gas per day from Bend lime at a depth of 5076 to 5120 feet. Total depth of the well is 5129 feet. The well is only three miles south of Wichita Falls. Farther south Adams' No. 1 Moer, just east of Scotland, Archer County, pumped 275 bbl. of oil in 45 hours from a total depth of 4148 feet. In the Hull-Silk pool, Archer County, Helmerich and Payne and Blackwell Oil and Gas Company's No. 2 Wilson-McCrory opened the third productive zone when it flowed 35 bbl. of oil per hour from a depth of 4348 to 4360 feet. The discovery well produces from the 3800-ft. zone and the same operators' No. 2 Wilson, the deepest well in the pool, on Railroad Commission gauge flowed 110 bbl. in five hours through open tubing from the Ellenburger lime at a depth of 5080 to 5109 feet.

AVERAGE CRUDE PRICES

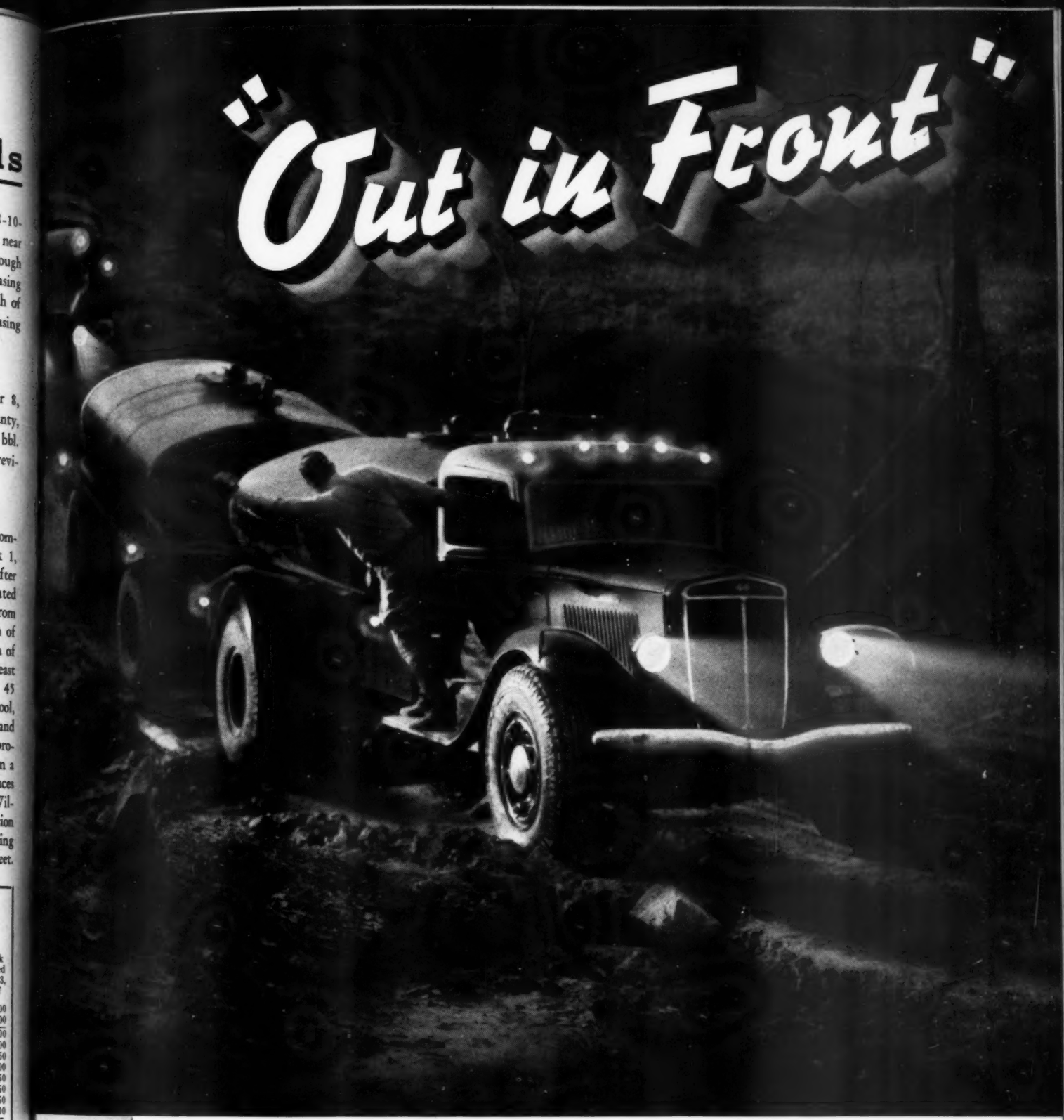
California	
Kettleman Hills	$1.19-1.43
Playa Del Rey	.80-1.16
Coalinga	.70- .90
Signal Hill	.80-1.21
Montana	1.35
Wyoming	.97-1.30
Colorado	1.12-1.18
New Mexico	.78-1.08
Texas	
North Central	.96-1.20
Panhandle	.91-1.08
West Texas	.78-1.08
Gulf Coast	.95-1.41
Darst Creek	1.09
East Texas	1.35
Talco	.73
Kansas	.98-1.30
Oklahoma	.98-1.30
Arkansas	.90
Louisiana	
Rodessa	$ .91-1.25
Gulf Coast	.84-1.41
North Louisiana	.90-1.22
Illinois	1.35
Kentucky	1.30
Indiana	1.12
Ohio	
Lima	1.00
Michigan	1.27
Pennsylvania	
Bradford	1.80
Southwest	1.46
Eureka	1.40
Buckeye	1.30
Corning	1.17
West Virginia	1.67
Canada	2.10-2.17

DAILY AVERAGE CRUDE OIL PRODUCTION
Data Supplied by A.P.I.

(Figures in Barrels)

	[1]B. of M. Dept. of Int. Calculations (July)	Week Ended July 2, 1938	Week Ended June 4, 1938	Week Ended July 3, 1937
Oklahoma	518,400	376,550	440,500	619,600
Kansas	172,300	143,150	138,200	193,000
Panhandle Texas		64,300	60,050	80,500
North Texas		73,200	72,350	72,600
West Central Texas		28,400	27,600	33,650
West Texas		181,750	178,850	200,600
East Central Texas		88,300	95,250	123,750
East Texas		364,300	363,250	466,550
Southwest Texas		203,850	204,950	236,450
Coastal Texas		188,350	187,450	202,500
TOTAL TEXAS	1,360,300	1,192,450	1,189,750	1,416,600
North Louisiana		79,400	76,300	88,300
Coastal Louisiana		184,250	181,400	173,050
TOT. LOUISIANA	260,600	263,650	257,700	261,350
Arkansas	51,000	51,100	43,300	28,350
Eastern	149,700	145,400	147,500	123,550
Michigan	56,400	53,450	54,750	43,100
Wyoming	55,500	61,100	51,400	48,900
Montana	13,500	13,650	14,850	17,200
Colorado	5,200	3,750	4,100	4,300
New Mexico	112,900	91,200	90,300	114,600
TOTAL EAST OF CALIF.	2,755,800	2,395,450	2,432,350	2,870,550
California	642,300	663,100	675,600	655,100
TOTAL U. S.	3,398,100	3,058,550	3,107,950	3,525,650

[1]These are Bureau of Mines' calculations of the demand for domestic crude oil based upon certain premises outlined in its detailed forecast for the month of July. As demand may be supplied either from stocks or from new production, contemplated withdrawals from crude oil stocks must be deducted from the Bureau's estimate of demand to determine the amount of new crude oil to be produced.



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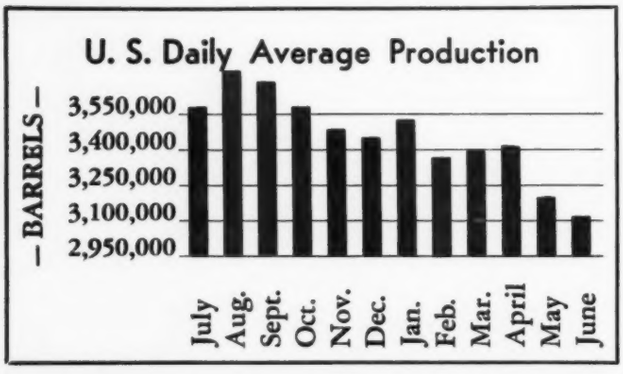
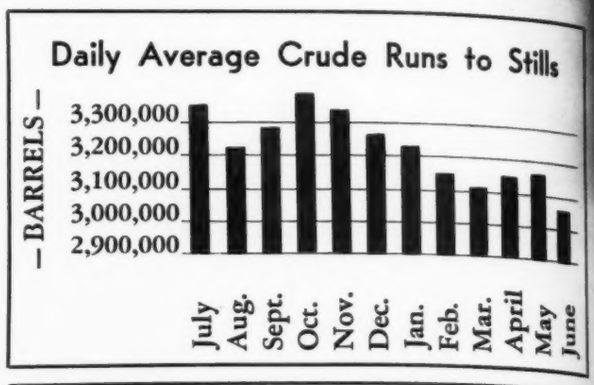
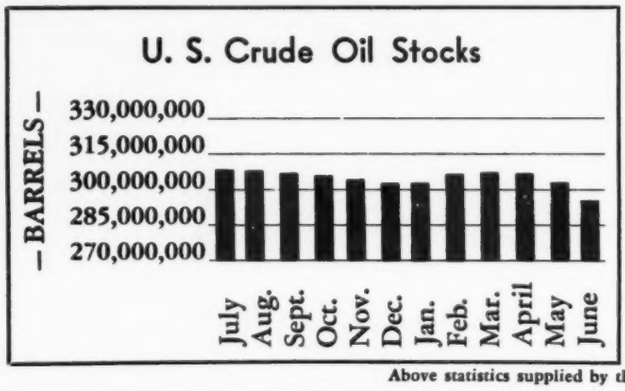
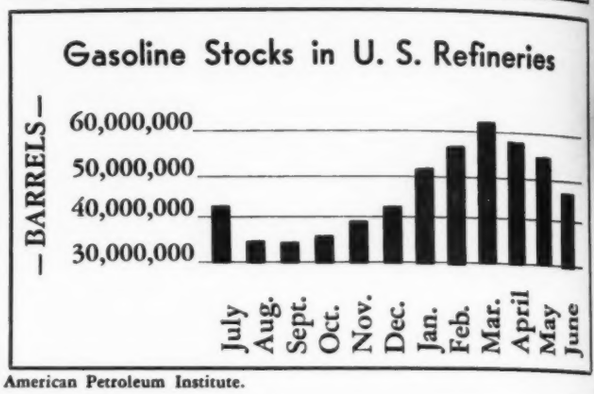
OIL AND GAS WELL CHEMICAL SERVICE

Summary of Petroleum Statistics and Field Activities









Above statistics supplied by the American Petroleum Institute.

Summarized Operations in Active Fields for June, 1938

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	150	146	37	110	3500-3700	2	40	Rotary
Duval County	47	40	5	19	1554-2900	2	22	Rotary
Ector County	67	67	16	70	3675-4377	2 and 3	32-36	Rot.-Cab.
Panhandle	53	53	40	139	1700-3900	2	40	Rotary
Refugio County	20	19	3	11	4900-5900	2	38	Rotary
Nueces County	33	29	9	30	3922-5878	2 or 3	21-54	Rotary
Winkler County	19	19	10	15	2850-3450	2 and 3	30-38	Rot.-Cab.
Talco Field	9	9	2	3	4230-4361	2	16-24	Rotary
K. M. A. Field	90	88	24	131	3730-3935	2	42-43	Rot.-Cab.
Oklahoma								
Oklahoma City	5	5	2	9	6450-6682	3	39	Rotary
Fitts Pool	23	19	2	8	1800-4488	2 or 3	38	Rotary
Kansas								
Russell County	21	18	4	24	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	18	14	2	15	3222-4085	2 and 5	42-48	Rot.-Cab.
Barton County	17	16	2	19	3290-3518	2	39-42	Rot.-Cab.
Louisiana-Texas-Arkansas								
Rodessa	13	13	5	17	5950-6450	3	39	Rotary
Illinois								
Central Illinois	93	71	37	190	2950-4100	2	36-38	Rot.-Cab.
New Mexico								
Lea County	44	41	20	91	3150-4030	3	30-34	Rot.-Cab.
California								
Kettleman Hills	4	4	2	14	8300-8730	3 or 4	40	Rotary
Wilmington	17	17	26	24	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for June, 1938

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1937 (In Barrels)
	June	May	June	May	June	May	June	May	June	May	
Arkansas	22	23	19	18	43	14	19	15	38	32	12,088,341
California	126	112	104	105	93	117	105	106	220	228	238,587,663
Colorado	1	....	0	....	....	....	1	2	20	28	1,532,893
Illinois	93	122	71	107	....	22	178	179*	63	62	7,376,022
Indiana	9	12	6	8	....	....	2	2	25	26	820,000
Kansas	150	143	117	101	125	125	30	35	191	229	70,542,000
Kentucky	67	64	45	44	....	....	15	17	81	75	5,500,000
Louisiana	124	72	98	53	157	94	52	54	225	189	90,501,068
Michigan	89	74	65	45	75	94	25	34	141	140	16,254,181
Mississippi	2	....	0	....	....	....	2	2	4	5	Gas Prod.
Montana	2	5	2	4	....	....	3	2	54	53	5,775,000
New Mexico	52	40	49	34	....	....	14	12	159	168	38,642,184
New York	14	....	14	....	....	....	....	....	....	....	5,466,200
Ohio	89	70	57	47	....	....	49	52	129	127	3,547,600
Oklahoma	211	201	144	154	154	207	34	45	277	321	225,402,731
Pennsylvania	....	....	....	....	....	....	....	....	....	....	19,154,400
Texas	1193	1228	917	964	1124	1319	399	439	1392	1457	506,891,233
West Virginia	50	45	35	34	....	....	21	26	105	98	3,833,000
Wyoming	9	10	8	8	....	....	5	8	69	71	19,402,121
Total	2303	2231	1751	1726	1771	1992	954	1030	3193	3309	1,271,316,637

*Includes 70 rigging up and 109 rigs standing.

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OKLAHOMA CITY
L. D. 785 Local 7-2725

WICHITA
L. D. 59 and 116
Local 2-1431 and 2-1432

AND BRANCH STORES

The Month's Activities in Refining

Percent Refining Capacity Operated

Western Division, 77.0 **Central Division, 70.9 Percent** **Eastern Division, 80.2 Percent**

PLANS are being made for the construction of several new refineries near Centralia, Illinois. Power Oil and Refining Corporation has just completed a 2000-bbl. per day plant. Officials of the company state they have made contracts with producers in Marion and Clinton counties for an adequate supply of crude to operate the refinery. The Phoenix Refining Company and the Egyptian Refining Company are the other two companies making plans for refineries in the area.

●

The construction of three new refineries to process Montana crude is being contemplated. Two of the plants, according to the plans, will be in Montana and one in North Dakota. Preliminary work already has begun on the construction of a 2000-bbl. refinery at Minot, North Dakota, by the Dakota Refining Company. A site has been obtained for the plant and officials of the company are negotiating for reduced rail rates from the Cut Bank field.

The Continental Oil Company is reported planning a refinery at Billings, Montana. A site has been selected near the Northern Pacific Railroad.

A proposal has been made by C. A. Teter and W. A. Jaynes, Great Falls, Montana, to the Williston, Montana, Chamber of Commerce to construct a 4000-bbl. refinery at that point. Acceptance of the plan is awaiting the approval of the State Securities Commission.

●

The Cosden Petroleum Corporation has placed in operation the Dubbs cracking unit recently installed at its refinery at Big Spring, Texas.

●

The Arab Gasoline Company, Eastland, Texas, is making tests in the Bryson field, Jack County, with a view to the possible erection of a natural gasoline plant. The company has been operating a compression-type plant south of Cisco but shut it down recently. If the plant is constructed in the Bryson field equipment from the old plant will be moved to the new location.

The Tri-State Refinery at Thermopolis, Wyoming, formerly the Fern Oil Company plant, has resumed operations. Initial capacity of the remodeled refinery is 300 bbl. per day. Crude supply is from the Black Mountain field, Hot Springs County, Wyoming. The plant is being operated by H. J. Walden as general superintendent, and C. F. Koenig as manager. The refinery is producing gasoline and tractor fuels for local consumption, it is announced.

●

The Swedish Parliament has under consideration the making of a government loan amounting to $2,000,000 to Rederi A/B Nordstjernan (North Star Navigation Company), Stockholm, for construction of a refinery. The loan has been approved by the Swedish Board of Trade. The output of the plant would be about 100,000 metric tons of motor fuel annually, of which 25,000 metric tons would be aviation gasoline.

●

According to a recent anouncement, the Shell Petroleum Corporation will remodel and enlarge its natural gasoline plant at Healdton, Carter County, Oklahoma. The plant will be converted from a compression to an absorption type unit and its capacity will be increased from 2500 gal. to 8000 gal. per day.

●

The Producers Gas Company, Hays, Kansas, is erecting a Girbotol plant in the Otis field for the removal of hydrogen sulphide from natural gas. This is the third such plant to be constructed in the field.

●

Byrd-Frost, Inc., Dallas, Texas, will place in operation this month their stage separation and recycling plant in the Long Lake field. H. W. Bass, Dallas, also may construct a similar type plant in the Long Lake field, it is announced, and the American Liberty Oil Company, Dallas, is conducting tests with a view to erecting such a plant in the Grapeland gas area, Houston County.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks
Week Ended July 2, 1938

A.P.I. Figures

(Figures in Barrels of 42 Gal. Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	480,000	71.7	22,342	12,272
Appalachian	88.4	108,000	83.7	3,130	1,168
Ind., Ill., Ky.	92.4	416,000	85.1	12,990	8,766
Okla., Kans., Mo.	84.7	287,000	74.9	7,126	4,146
Inland Texas	56.6	123,000	61.2	2,172	1,712
Texas Gulf	95.7	730,000	91.6	9,904	11,248
La. Gulf	96.6	106,000	63.1	2,775	3,420
No. La.-Ark.	63.7	37,000	63.8	463	805
Rocky Mt.	69.7	58,000	93.5	1,945	912
California	90.9	451,000	60.5	13,637	91,644
Reported	89.0	2,796,000	75.5	76,484	136,093
Est'd Unreported		299,000		4,150	2,810
*EST'D TOTAL U.S. July 2, '38		3,095,000		80,634	138,903
*EST'D TOTAL U.S. June 25, '38		3,025,000		82,412	137,801
U.S. B. of M. *JULY 2, 1937		**3,380,000		74,964	102,262

*Estimated Bureau of Mines basis.
**July, 1937, daily average.

THE Petroleum Engineer

JULY, 1938

Natural Gasoline Plants in K. M. A. Field Equipped For Pressure Maintenance

Life of field will be prolonged and recycling of gas will assure ample supply for processing for some years to come

By FRANK H. LOVE

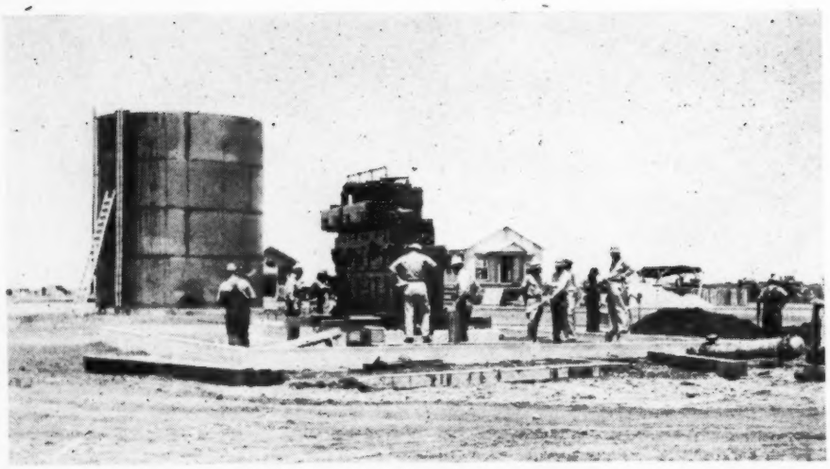
BECAUSE reservoir pressure is declining rapidly in the deep producing zone of the K.M.A. field, Texas, the natural gasoline plants now operating, as well as those under construction, are equipped for returning residue gas to the sand. This procedure will serve a twofold purpose in that it will prolong the life of the field and assure for some years to come an ample supply of wet gas for processing. All plants are of the compression type.

The plant of the Deep Oil Development Company, the first to be erected, has been in operation since late in December. This unit operates on three-stage compression, two stages for the extraction of gasoline and one stage for repressuring. The capacity of the plant is 1,200,000 cu. ft. of gas per day, a part of which is being returned to the sand. The company is taking gas only from its own wells, at present numbering 28.

The principal equipment consists of a 250-hp. compressor unit, a 66-ft. stabilizer tower, two treating columns to remove the trace of sulphur present in the gas, and a cooling tower having a capacity of 450 gal. per minute. Steam required by the stabilizer is provided by an 85-hp. boiler. Two centrifugal pumps, one for circulating water to the engine jackets and the other for boosting water over the cooling tower, are also a part of the plant's equipment.

The Deep Oil Development Company's plant is manufacturing a 14-lb. gasoline at the present time, and is returning gas to the producing zone at a pressure of 1150 pounds.

View of Phillips Petroleum Company and Sunray Oil Company's Mankins gasoline plant while under construction



Erecting one of Continental Oil Company's three plants

The Mankins gasoline plant, owned jointly by the Phillips Petroleum Company and the Sunray Oil Company and operated by the former, only recently made its test run and was placed on steady production. The plant, situated in the central part of the K.M.A. field, has a capacity of 5,000,000 cu. ft. of gas per day. About 35 miles of gathering lines 4 in. to 16 in. in diameter bring the wet gas to the plant where it is compressed by four 165-hp., horizontal-type compressors. An 80-ft. column is employed for stabilizing the gasoline after it has been extracted from the gas. The cooling tower, which has a capacity of 120 bbl. of water an hour, is served by two centrifugal pumps. Altogether there are eight centrifugal pumps for circulating water including those on the tower and those used for engine jacket water. The engine water cooling system incidentally is enclosed. After leaving the engine jackets the water is cooled by circulating through coils in the cooling tower, being returned to a vertical supply tank. Use of this system obviates the need for a second cooling tower, and the supply tank also serves to maintain a head on the water pumps.

The intake and discharge headers for the compressor units, as well as the water header to the engines, are carried aboveground outside the compressor building, being secured by means of turnbuckles to sections of pipe placed at right angles, these in turn being supported on concrete.

Because of the type of the plant only a small quantity of steam is required, and that needed for the stabilizing tower, steam pumps, radiators, etc., is supplied by two 80-hp. boilers.

An auxiliary unit for generating electricity consists of an 80-hp. gas engine driving a 60-kw. generator.

The finished gasoline is stored in five 10-ft. by 40-ft. horizontal tanks until pumped through a 3-in. line to the Mankins loading rack six miles distant.

Gas is received at this plant at 15-in. vacuum, and is compressed to 40-lb. pressure in the low stage of compression, and to 250-lb. discharge pressure.

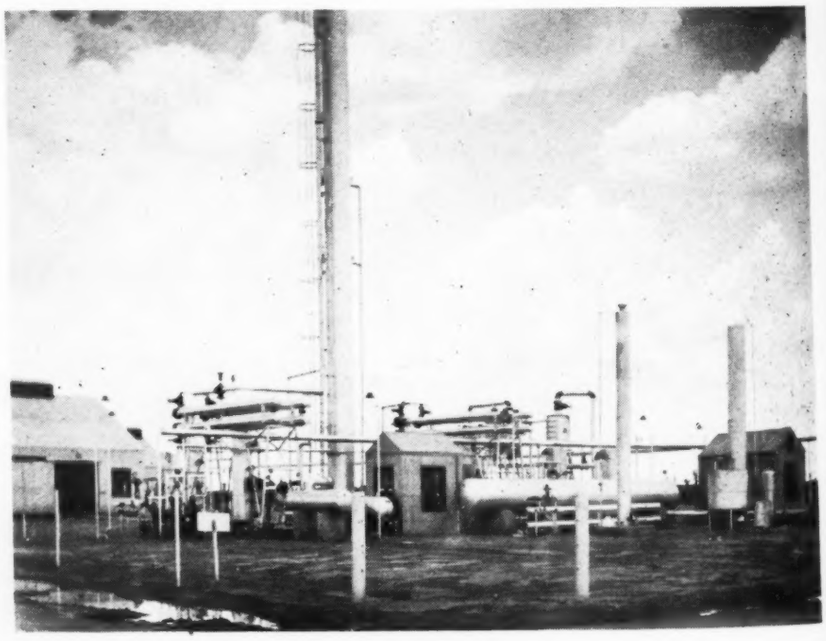
Although residue gas is not being returned to the producing sands at present, high-pressure residue lines have been provided for pressure maintenance at a later time when producers require this service.

The Continental Oil Company is adopting an arrangement of its gasoline plants that is somewhat unusual but one that company officials believe will be more economical and efficient for pressure maintenance. This company is constructing three gasoline plants, the combined capacity of which will be 9,000,000 cu. ft. of gas per day. They will have individual gathering systems and each will manufacture raw gasoline. At only one plant, however, will stabilizing equipment be provided, raw gasoline from all plants being piped there for finishing. Provision is being made to return residue gas to the sand at whatever pressures are required by the producers. The individual plants are being equipped for pressure maintenance. It is believed that because of the difference in pressure requirements of the various wells each plant can serve the wells in its area better than a centralized plant could serve the entire field.

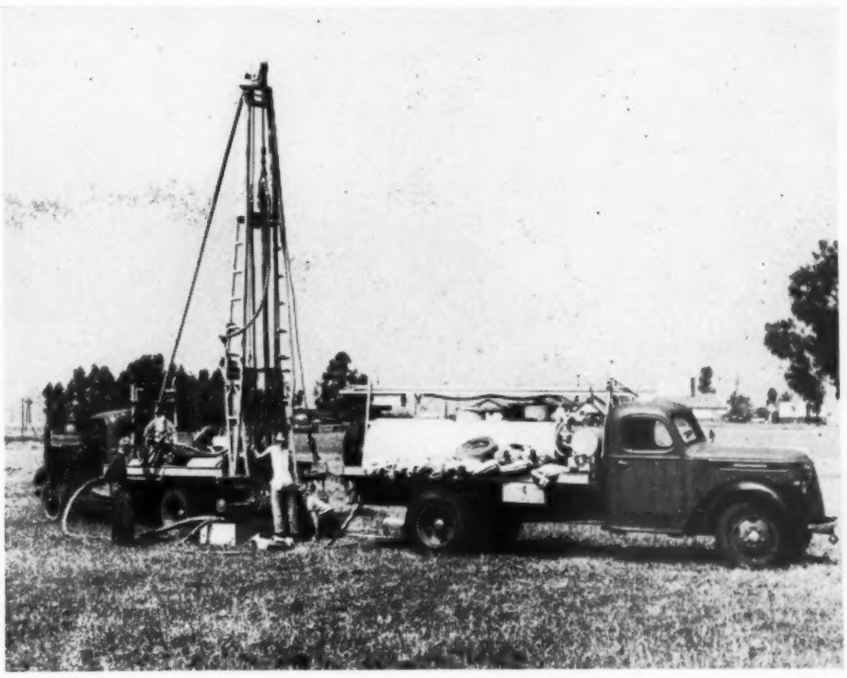
One of the Continental plants, the one at which the gasoline will be stabilized, is situated in the north-central part of the field, another in the southwestern part of the field, and the third in the southeastern part. All will be operated on three stages of compression, two for removing gasoline from the wet gas and one for pressure maintenance. Compressor equipment consists of 400-hp. units. At the plant where the gasoline is stabilized a cooling tower and steam equipment have been provided.

The gathering system for the three plants is composed of approximately 80 miles of pipe line in sizes from 2-in. to 18-inch. A 3-in. line is being laid to the company's refinery at Wichita Falls as an outlet for the finished product.

The Continental's plants are expected to be placed in operation by August 1st.



The first gasoline plant completed in the field, that of the Deep Oil Development Company



Drilling a shot hole in Los Angeles Basin. Mud in sacks for making circulating fluid is carried by the water truck, as well as water, drill pipe, and, when necessary, casing for the shot hole. (Photo courtesy Western Geophysical Company)

By
WALLACE A. SAWDON
Petroleum Engineer,
Los Angeles

Geophysics Has Proved Its Importance in California Prospecting

THE value of geophysics in California has been brought to the attention of the industry in a rather dramatic manner by the discovery of the Rio Bravo field, credited to geophysical prospecting, and the location of Continental Oil Company's deep well by the same means. Geophysical prospecting has been practiced for many years and several fields have been discovered by geophysics. It is natural, however, that interest should be focused on the means of discovery of the two deepest producing areas in the world.

Although the entire southern part of the San Joaquin Valley from the Coalinga field to its southern boundary and from the east to the west mountain range has been geophysically explored, the area of most intensive prospecting recently has been that north and west of Bakersfield, as shown on the accompanying map. The portion here indicated by cross-hatching is at present the center of greatest interest. As can be seen, this area includes the Wasco discovery well and the Rio Bravo and Greeley fields.

Specifically, this is a structural trend in which the sand, known as the Rio Bravo because discovered at Rio Bravo, has yielded commercial production in the Continental well on the north and is evidently productive as far south as the Greeley field, indications of saturation having been observed in a Standard Oil Company well there drilled to a depth exceeding 11,500 feet.

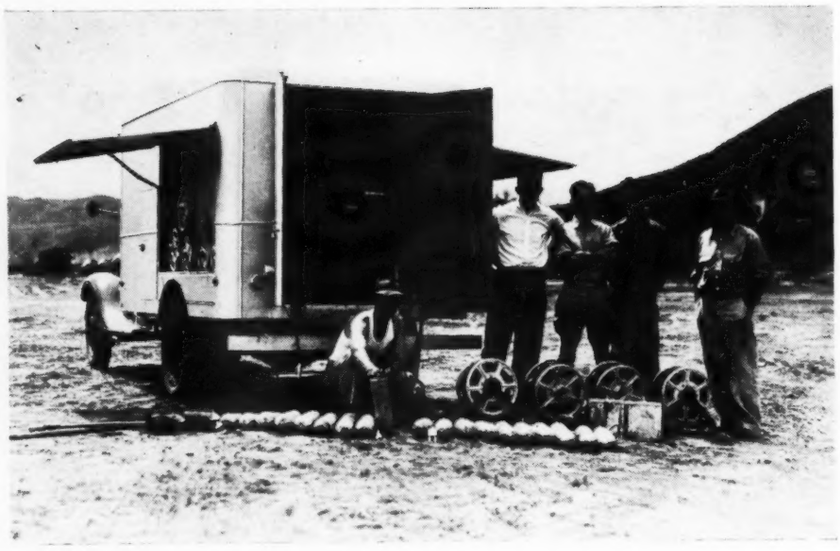
Geological exploration is difficult because the ordinary sedimentary strata are covered by a deep overburden of alluvium. It is believed by some operators that the entire area is productive at depths exceeding 11,000 ft., although what faulting, folding, and unconformity exist cannot be discovered without actual tests. One test well is now being drilled by the Standard Oil Company between Rio Bravo and Greeley and its progress is being watched with intense interest.

Farther south is the Buena Vista Lake gas field where the Ohio Oil Company is drilling a deep test. The original field purports to have been the second geophysical discovery in the state and the deep test was started on the basis of geophysical data. A sand, said to be the Stevens, was cored at a depth slightly exceeding 10,000 ft., but the well is being drilled deeper. Should this be the same structural trend as that through the Greeley-Rio Bravo-Wasco fields there is, of course, the chance of obtaining production from the Rio Bravo sand. When rigging-up the well the company was reported to be contemplating drilling to a depth of 15,000 ft. or more and this intention was rumored before the Continental well was drilled to its record depth of 15,004 feet.

The eastern side of San Joaquin Valley has not been as actively explored during the last year as has the territory north and west of Bakersfield but previous geophysical prospecting has been done over much of the area. Interest has not been as intense in the coastal districts, although the value of geophysics, which was credited with location of the Santa Maria Valley production, is recognized and some geophysical work is being done at the present time.

Geophysical exploration in the Los Angeles Basin has been more active, especially during the last few months, despite the fact that probably the entire area has been mapped by several geophysical methods during the last few years. The work here is sometimes limited by shooting conditions as almost the entire area is covered by ranches and groves. Many crop damage suits against geophysical prospecting companies have been successfully prosecuted in this district.

Geophysical parties of three or four of the oil companies are operating at



A 20-trace recording truck with equipment ready to be set up for geophysical recordings. (Photo courtesy Rieber Laboratories)

the present time. All the other companies use commercial geophysical service. A company has been known to use its own parties and then employ one or two other services to augment data provided. If outside service alone is used, two or more companies sometimes report on an interesting area before the test well is located. This practice is now the exception, as geophysical prospecting has advanced to such a stage that its percentage of hits has greatly increased confidence in its reliability.

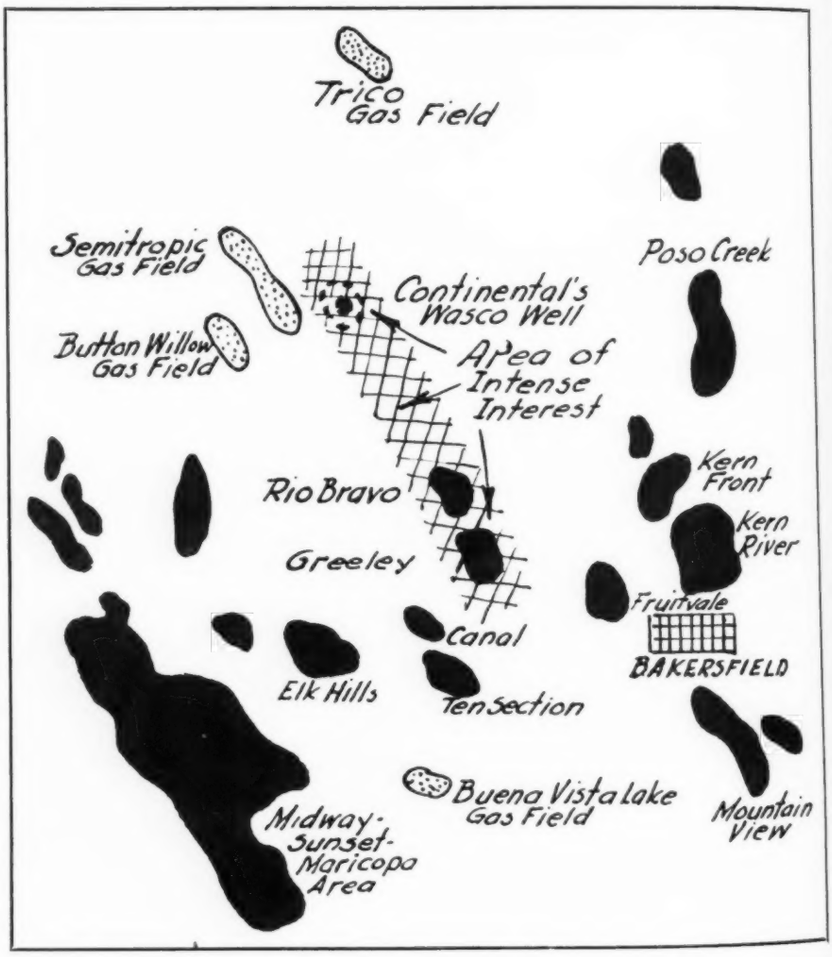
Several methods of geophysical prospecting[1] are being employed but the reflection seismograph has been used to the greatest extent in exploratory work in all parts of California. In addition to the usual reflection seismograph methods the equipment using sound waves is also employed. This instrument transforms the reflection waves into sound waves and records them automatically on a sound track for reproduction and analysis in the laboratory.

Under some conditions the electrical method of geophysical prospecting has been used to advantage. When this method is employed the resistivity of the subsurface is determined by passing an electric current between two electrodes, the depth of penetration being governed largely by the distance between the two electrodes.

Instruments and transportation units with facilities for operation have all been improved during the last year. Field practice has therefore shown steady development toward increased efficiency. This is a natural result of the demand for a closer approach to precision that has followed better office procedure and interpretation of data. All these improvements are the outgrowth of wider experience in field, laboratory, and office.

The coordination of geology and paleontology with the geophysical findings has provided a rather comprehensive picture of subsurface conditions in many active or prospective areas. The whole process of discovering a field involves this coordination when economic and efficient development is to follow, although the decision to drill and the selection of the location may be based on geophysical exploration alone.

[1]Complete descriptions of the various geophysical methods are given in a symposium on "Modern Petroleum Prospecting Methods" in the February, 1937, issue of *The Petroleum Engineer*.



In this area of California geophysical prospecting was the most active during the last year

Established Method Adapted to Cementing of Wells Drilled Through Mine Tunnels

Modification of multiple-stage cementing procedure permits its use in compliance with strict state law

By

J. R. BRADSHAW*

AS water intrusion in the Centralia oil field of Illinois is causing a great deal of trouble, especially in the adjacent coal mining district, strict rules governing the cementing of water sands are being rigidly enforced.

Many of the operators are solving this difficult problem by the use of a multiple-stage cementing device that has been on the market for several years and has been tested in many other fields. By means of this device it is often possible to effect a considerable saving by elimination of one or more strings of casing used for water protection. Instead of running a protection string operators mud-off the water sands as encountered until one string can be run. The annular space between the casing and the wall of the hole is filled with cement and by utilizing the multiple-stage cementing device the shallow water sands are completely shut off. Use of this device

*Engineer, Halliburton Oil Well Cementing Company.

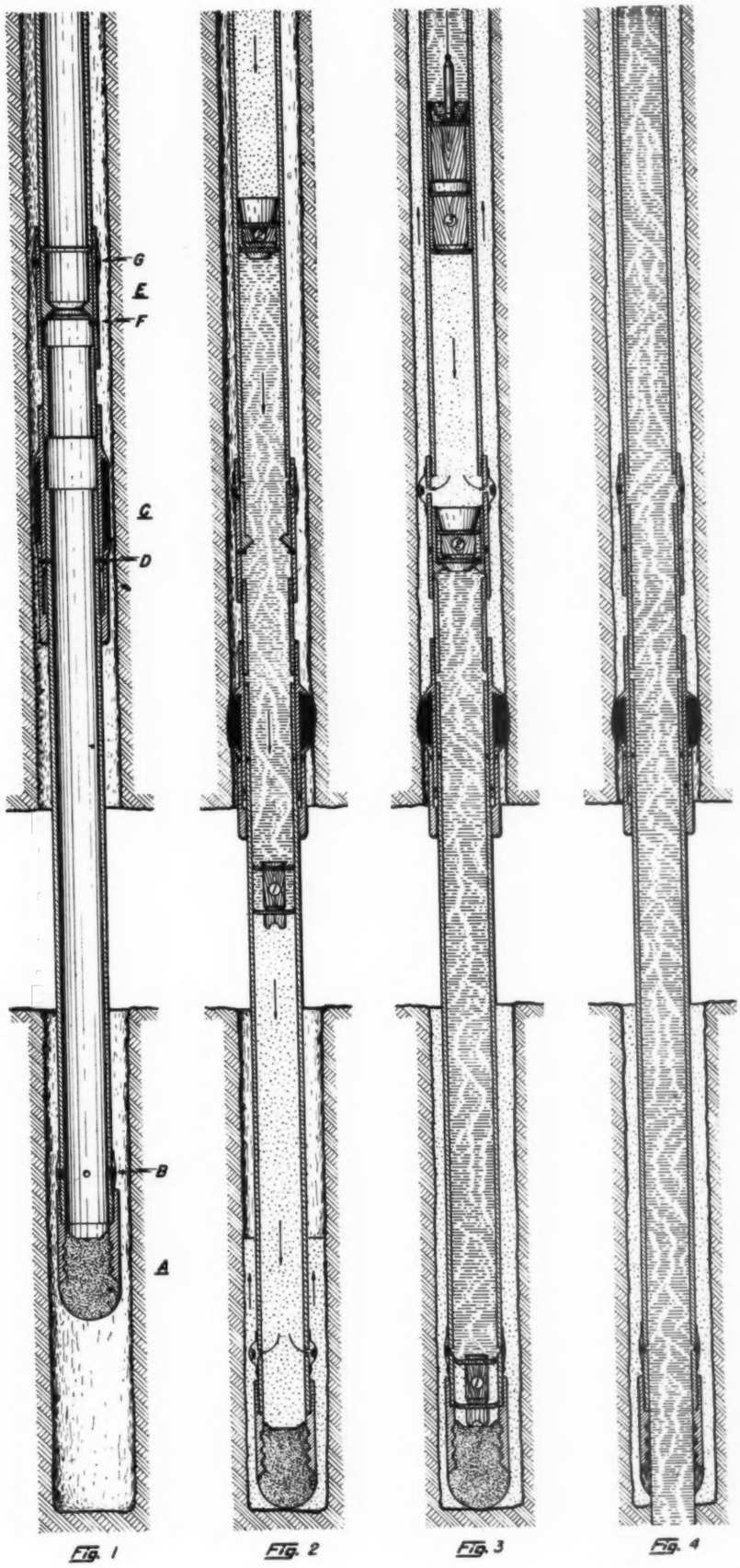


FIG. 1 FIG. 2 FIG. 3 FIG. 4

Procedure for placing the two separate slurries of cement

assures the placing of a solid uncontaminated body of cement across the face of each sand drilled. This procedure has proved practicable as well as economical.

When a drilling well actually penetrates one of the mine tunnels a peculiar cementing problem arises. The drilled hole above the tunnel roof is emptied by loss of circulation into the tunnel itself. Both because of the necessity for insuring mud returns at the surface, and because of stringent regulations imposed by the state for protection of the mine workings, it is necessary to set and cement casing in the hole through the tunnel from the tunnel roof into the formation under the tunnel floor. A suggested means for successfully completing a job of this type is the use of the multiple-stage cementing device and an open-hole packer of a commonly-used type, in conjunction with a solid-nosed guide shoe and a joint of casing provided with a set of fluid passage ports.

The procedure for placing the two separate slurries of cement is briefly as follows: Fig. 1 represents the assembly being lowered into a well that has drilled through the roof and into the floor below to a depth of approximately 75 or 100 feet. A full-nosed cement guide shoe, A, is screwed on the lower end of the casing. Ports, B, have been drilled in the casing just above the guide shoe and preferably are closed from the outside by clapper valves, held in place by strips of spring steel. An ordinary rubber or canvas packer, C, is reinforced by steel shoes on top and bottom of the packer itself. Shear pins, D, hold the packer in an elongated position until the weight of the casing is set on it. The multiple-stage cementing device, E, consists of a sliding sleeve and beveled seat. Shear pins, F, support the sleeve, thus covering the ports until the plug 2 seats and is pumped to the shoulder below. The ports, G, are also closed from the outside by clapper valves thus preventing cement from flowing back into the pipe after it has been pumped into place between the wall and the casing.

Figs. 2, 3, and 4 show the first slurry of cement being pumped to the bottom of the casing and out the lower ports thus completely filling the cavity to the level of the floor. At the same time the second slurry is being forced outward through the upper ports completely shutting-off water sands and cementing the entire string of casing in place. The plugs are then drilled-out and drilling continued in the ordinary manner.

Obviously the displacement of the first slurry and of the fluid between plugs 1 and 2 must be calculated accurately.

The Lubrication and Care of Geared Pumping Reducers

« By KENNETH N. MILLS*

THE life of a geared speed-reducer is dependent on two factors, lubrication and load. Once a reducer is selected and applied the variable load is removed and thereafter its life is dependent on proper lubrication.

Proper lubrication involves more than selecting a high-grade, high-quality, well-refined lubricating oil. It includes supplying the reducer with clean oil of the proper viscosity for the operating temperature encountered, maintaining the proper oil level, draining and cleaning the gear case at regular intervals, keeping the gear case oil-tight, and cleaning the breather air filter at regular intervals.

The viscosity of oil used in the reducer should be that recommended by the manufacturer for the operating temperature encountered. If the manufacturer does not make any recommendations, selection of lubricant should be based on the A.P.I.'s recommendations, shown in Table 1. If the manufacturer's recommendations on the grade of lubricant do not agree with those of the A.P.I., his recommendations should be used, as his design may employ some features necessitating a different grade of lubricant.

Care should be exercised to make certain that the oil entering the reducer is free from grit and foreign matter. Before the oil entrance hole cap is removed all the dirt should be wiped from around it, so that when the cap is removed no dirt will fall into the gear case. The pail used to transfer the oil from the storage tank to the reducer must be clean, and care must be exercised to see that no dirt or moisture enters the oil before it reaches the reducer. If any gritty matter enters the reducer it will cause excessive gear and bearing wear, thereby shortening the useful life of the reducer.

After a new reducer or one that has been drained and cleaned has been filled to the proper level with the correct grade of lubricant, it should be operated for approximately 15 minutes under no load. This procedure should be followed to permit the bearing oil reservoirs to become filled with oil, so the bearings will not be called upon to operate under full load with insufficient lubrication. After this period of no-load operation, the oil level should be rechecked, and if it is low sufficient oil should be added to bring it to the proper level.

When a new reducer has been in service about one month it should be drained and the case flushed and refilled with new oil or old oil that has been carefully filtered. If the old oil contains water it should not be used until the water is removed, as water will cause rust and will also result in poor lubrication. To flush the reducer the case should be filled to the proper level with crankcase flushing oil and operated approximately one-half hour under no load. The reducer should then be drained and refilled with the proper lubricant. After refilling with new oil the reducer should be operated about 15 minutes before the load is applied. The reducer, following this outlined procedure, should be drained, flushed, and refilled with new oil once each six months thereafter.

If the reducer has an air filter on its vent, each time the oil is drained the air filter should be cleaned with kerosene or gasoline and resaturated with oil if required.

If this procedure is followed, and oil of the proper visocity used, the user of the geared unit will be repaid many times for his trouble by long gear life and minimum loss of production caused by shut-downs from premature gear and bearing failures.

TABLE I

Viscosity of lubricant at 100 deg. fahr.
(Saybolt Seconds)

Center distance of main gears	Operating temp. 40 - 100 deg. fahr.	Operating temp. 0 - 40 deg. fahr.	Pour point
To 14 in.	750 - 1000	450 - 600	0 - 10° F.
15 in. to 40 in.	1200 - 1800	750 - 1000	10 - 20° F.

*Chief Engineer, American Manufacturing Company of Texas.

Practical Dynamometer Tests‡

Part 2

By H. N. MARSH* and E. V. WATTS*

OFFICE PROCEDURE

Office procedure can be presented best by discussing an actual test. Well "A" had been producing an average of 135 bbl. per day gross for more than eight months with practically no decline and little trouble; and, although it was suspected that the well was capable of producing more, it was desirable to have some concrete data on the existing load and performance before making any changes. A sub-surface pressure test would have been helpful; but, because there were two joints of 2-in. tubing on bottom, the gauge available could not be run without pulling tubing. Owing to the depth of the hole, this type of test would have required much time and expense, and would have given no information on the equally important question of rig loads. Therefore, a preliminary investigation was made with the dynamometer. The pertinent data and results are given in Table 2.

Using this well as an example, the calculation of results is presented herewith.

*General Petroleum Corporation of California, Los Angeles.

‡Paper presented at Eighth Mid-Year Meeting, American Petroleum Institute, Wichita, Kansas, May 24, 1938.

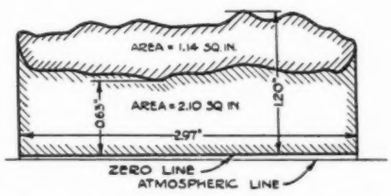


Fig. 6. Measurements of dynamometer card—Well "A"

Computations of Equipment Performance

If on the dynamometer card (refer to Fig. 6),

D max. = 1.20 in. = maximum deflection

D min. = 0.63 in. = minimum deflection

A_2 = 1.14 sq. in. = upper area

A_1 = 2.10 sq. in. = lower area

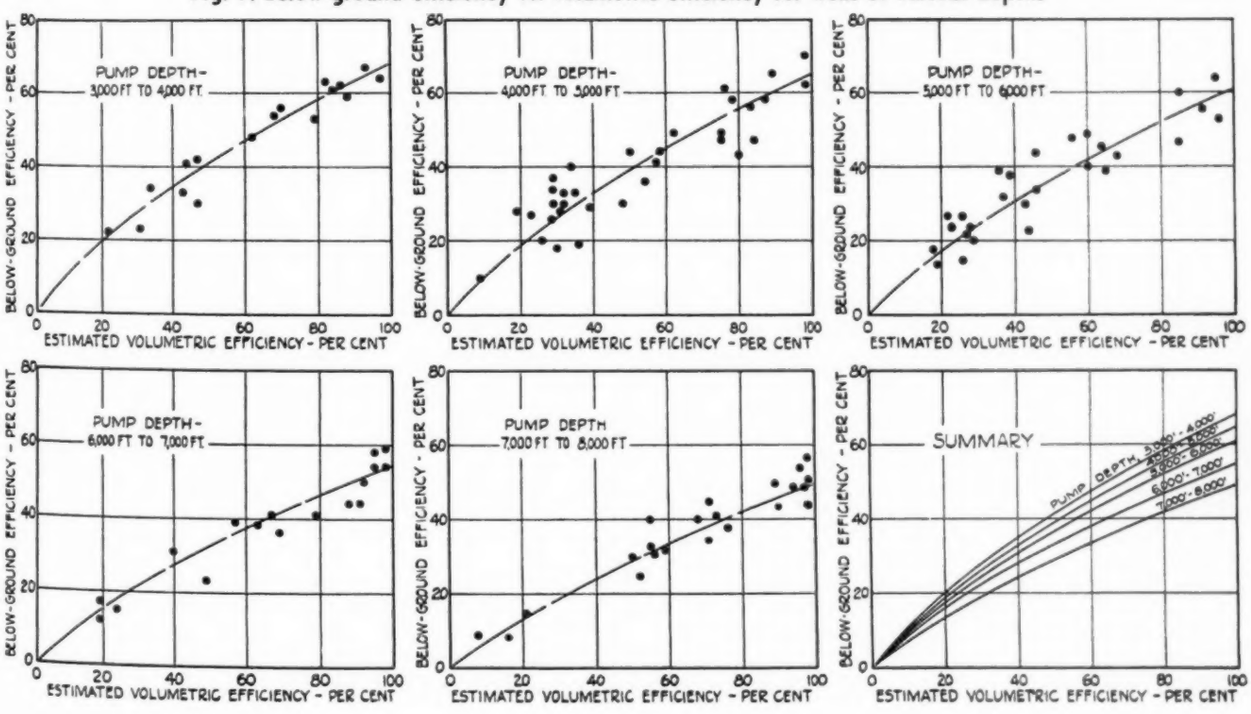
L = 2.97 in. = length of card

and C = 12,800 lb. per in. = calibration constant of dynamometer

Then the following computations can be made:

1. Maximum load = C × D max. = (12,800) (1.20) = 15,400 lb.
2. Minimum load = C × D min. = (12,800) (0.63) = 8,100 lb.
3. Average upstroke load = $C\left(\frac{A_1 + A_2}{L}\right) = 12{,}800\left(\frac{2.10 + 1.14}{2.97}\right) = 14{,}000$ lb.
4. Average downstroke load = $C\left(\frac{A_1}{L}\right) = 12{,}800\left(\frac{2.10}{2.97}\right) = 9{,}100$ lb.
5. Correct counterbalance = $C\left(\frac{A_1 + \frac{A_2}{2}}{L}\right) = 12{,}800\left(\frac{2.10 + \frac{1.14}{2}}{2.97}\right) = 11{,}500$ lb.
6. Horsepower at polished rod = $C\frac{A_2}{L}\left(\text{length of stroke (ft.)} \times \frac{\text{strokes per minute}}{33{,}000}\right) = 12{,}800\left(\frac{1.14}{2.97}\right)\left[\frac{45\ (18.5)}{12\ (33{,}000)}\right] = 10.3$ hp.

Fig. 7. Below-ground efficiency vs. volumetric efficiency for wells of various depths



7. Above-ground power efficiency = $\frac{\text{polished-rod hp.}}{\text{input hp.}} = \frac{10.3}{17.6} = 59$ percent

8. Below-ground efficiency: Theoretical hp. required to lift the fluid, assuming fluid level to be at the pump =

$$\frac{\text{bbl. per day} \times \text{weight per bbl. (lb.)}}{1440} \times \frac{\text{depth to pump (ft.)}}{(33{,}000)}$$

$$= \frac{(134)\ (307)\ (6{,}712)}{(1{,}440)\ (33{,}000)} = 5.8 \text{ hp.}$$

Then, the below-ground efficiency

$$= \frac{\text{theoretical hp.}}{\text{polished-rod hp.}} = \frac{5.8}{10.3}$$
$$= 57 \text{ percent.}$$

Results of a number of tests in one field have been summarized in Fig. 7, in which below-ground efficiencies have been plotted against the volumetric efficiencies estimated by the Coberly method.[6]

[6] C. J. Coberly, discussion of paper by H. N. Marsh, "High Volumetric Efficiency in Oil-Well Pumping and Its Practical Results," *Proc. A.P.I.* 12M (IV) 57 (*Prod. Bull. No.* 207) (1931).

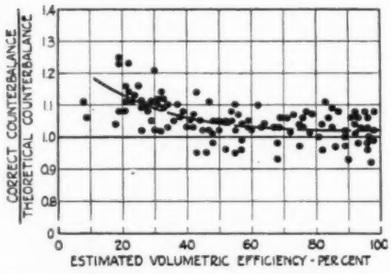


Fig. 8. Effect of volumetric efficiency on correct counterbalance

9. Peak torque: Inasmuch as it is usually necessary to know only if the torque rating is exceeded, a conservative estimate can be made by multiplying half the stroke length by the difference between the effective weight of the counterbalance and maximum load, or minimum load, whichever difference is greater. In well "A":

Peak torque is less than

$$\frac{45}{2}(15{,}400 - 11{,}500)$$

is less than 88,000 in-lb.

If this estimate exceeds the rating of the machine, a trial-and-error determination should be made in which the position of the crank is taken into account.

Computation of Theoretical Loads

In addition to these quantities, it is important to know, for the purpose of comparison, the theoretical loads on the upstroke and downstroke.

10. Theoretical downstroke load
= weight of rods in oil
= length × weight per ft.
= (6,699) (1.482) = 9,900 lb.

where 1.482 = weight per ft. of ¾-in. rods in 29.5-deg.-gravity oil.

11. Theoretical upstroke load = downstroke load + fluid load on gross plunger area
= downstroke load + depth to pump × pressure gradient of oil (lb. per sq. in. per ft.) × area of plunger.
= 9,900 + 6,699 (0.380) (1.227)
= 9,900 + 3,100 = 13,000 lb.

12. Theoretical counterbalance may

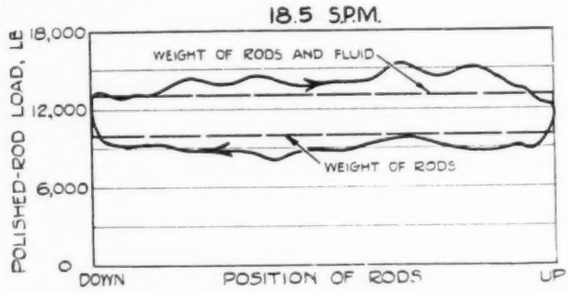
TABLE 2
Pumping-Well Operation
WELL "A"

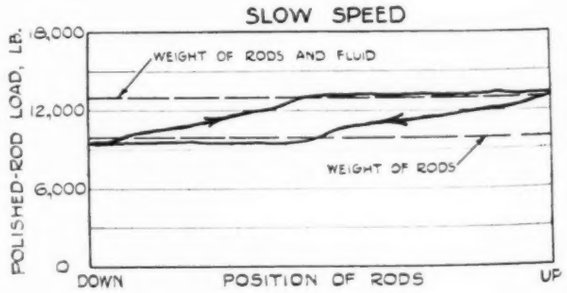
Well
- Present depth, 6,890 ft. — Casing, 4¾-in. to 7,260 ft.
- Liner, none — Perforations, from 6,250 ft. to 6,885 ft.
- Pump depth, 6,712 ft. — Tubing, 6,668 ft. of 2½-in. and 44 ft. of 2-in.
- Pump, 2-in. × 1¼-in. rod, sectional liner
- Sucker rods, 6,699 ft. of ¾-in.
- Gas anchor, outer tube, 3 in. × 14 ft. — inner tube, ¾ in. × 8 ft.
- Production, gross, 134 bbl. — Net 108 bbl.
- Gravity of WET oil, 29.5 deg. A.P.I.
- Gas-oil ratio, 550 cu. ft. per bbl. of oil
- Casing, open to line — Casing pressure, 0

Rig
- X rig front
- Length of stroke, 45 in. (3rd crank hole)
- Pumping speed, 18.5 strokes per minute
- Reduction unit, chain and sprocket — Ratio, 22.2 to 1
- Counterbalance, rotary — Number of weights, 10 lead
  - Present effective weight, 11,200 lb. (A.P.I. rating)
  - Theoretically-correct weight, 11,450 lb. (calculated)
  - Correct weight, 11,500 lb. (by dynamometer)

Motor 25- to 65-hp. Full-load speed, 470 to 970 r.p.m. at 50 cycles
- Controller point, 5 (9 is wide open)
- Power input, 17.6 hp.
- R.p.m., average, 410 — Motor temperature, 35 deg. cent. — Air temperature, 22 deg. cent.

Dynamometer Cards





Dynamometer Data

Maximum load,	15,400 lb.	Above-ground efficiency,	59 percent
Minimum load,	8,100 lb.	Below-ground efficiency,	57 percent
Power at polished rod,	10.3 hp.	Estimated volumetric efficiency,	98 percent
Peak torque,	88,000 in-lb.		

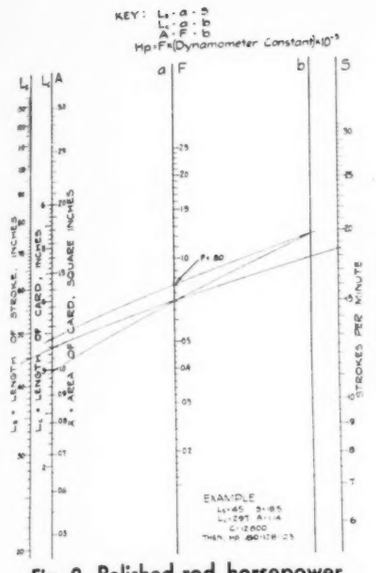


Fig. 9. Polished-rod horsepower

be computed by averaging the theoretical upstroke and downstroke loads, but has little value. As shown in Fig. 8, the correct counterbalance by the dynamometer is, on the average, higher than the theoretical, especially with low volumetric efficiencies.

Computation of Volumetric Efficiency

Several methods have been devised for computing the plunger travel in pumps, and will not be reviewed at this time.[5, 6, 7, 8] Each has certain limitations, and at present it is not possible to decide which is best applicable to a given well. However, so long as the engineer recognizes the limitations of the particular method used, he will not be especially handicapped in understanding his well problems and improving the operation.

The plunger travel for well "A" was obtained by subtracting from the polished-rod stroke the calculated stretch of 24 in. in the rods and tubing and adding the over-travel of 13 in.

[5] H. N. Marsh, "High Volumetric Efficiency in Oil-Well Pumping and Its Practical Results," *Proc. A.P.I.* 12M (IV) 47 (*Prod. Bull.* No. 207) (1931).

[7] Robert William Rieniets, "Plunger Travel of Oil-Well Pumps," *Drilling and Production Practice*, 1937, 159.

[8] Emory Kemler, discussion of a paper by W. E. Gilbert, "An Oil-Well Pump Dynagraph," *Drilling and Production Practice*, 1936, 114.

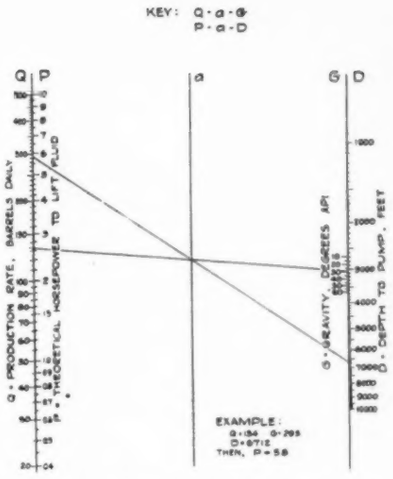


Fig. 10. Theoretical horsepower to lift fluid

due to acceleration as given by Coberly.[6] With a plunger stroke of 45 — 24 + 13 = 34 in., the volumetric efficiency is computed to be 116 percent. This fictitiously high figure can be attributed to either a high fluid level,

TABLE 3
Pumping-Well Operation
WELL "B"

Well

Present depth.	5,750 ft.	Casing, 9-in. to 6,310 ft.	
Liner,	none	Perforations from 5,600 ft. to 5,740 ft.	
Pump depth,	5,726 ft.	Tubing, 5,635 ft. of 3-in. and 91 ft. of 2½-in.	
Pump	2-in × 1¼-in. rod, sectional liner		
Sucker rods,	1,456 ft. of ⅞-in. and 4,055 ft. of ¾-in.		
Gas anchor,	outer tube, 3 in. × 20 ft. Inner tube, ¾ in × 8 ft.		
Production,	gross, 41 bbl.	Net, 21 bbl.	
Gravity of WET oil,	21.8 deg. A.P.I.		
Gas-oil ratio,	280 cu. ft. per bbl. of oil		
Casing,	open to line	Casing pressure, 0	

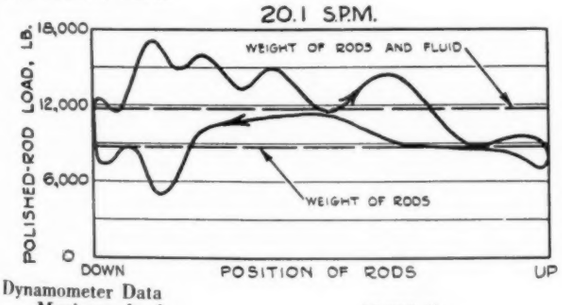
Rig

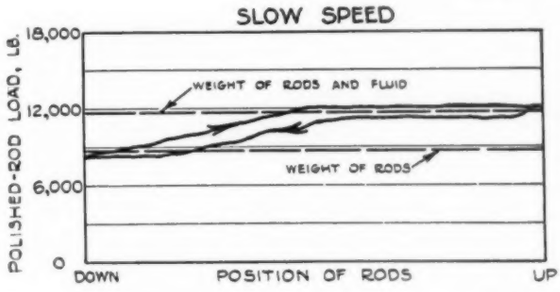
Length of stroke,		X rig front 44½ in.	
Pumping speed,		20.1 strokes per minute	
Reduction unit,	chain and sprocket	Ratio, 22.2 to 1	
Counterbalance,	rotary	Number of weights, 10 lead	
Present effective weight,		11,300 lb. (A.P.I. rating)	
Theoretically-correct weight,		10,200 lb. (calculated)	
Correct weight,		10,750 lb. (by dynamometer)	

Motor 25- to 65-hp. Full-load speed, 470 to 970 r.p.m. at 50 cycles.

Controller point,		4 (9 is wide open)	
Power input,		13.2 hp.	
R.p.m., average,	446	Motor temperature, 35 deg. cent.	Air temperature, 24 deg. cent.

Dynamometer Cards





Dynamometer Data

Maximum load,	17,300 lb.	Above-ground efficiency,	50 percent
Minimum load,	5,000 lb.	Below-ground efficiency,	24 percent
Power at polished rod,	6.6 hp.	Estimated volumetric efficiency,	29 percent
Peak torque,	142,000 in-lb.		

which would reduce the stretch, or to the error in estimating the over-travel. In either case, it is still evident that the pump actually had a very good efficiency; a value of 98 percent was arbitrarily selected.

Inasmuch as most of the calculations which have been listed require reference to tabular data for such quantities as the weight per ft. of rods in oil, pressure gradient, constants, etc., alignment charts are helpful—especially if many tests must be computed. Figs. 9, 10, 11, and 12 illustrate some of the charts which can be made, with calculations for well "A" shown as examples.

Changes in Operation Suggested by Results

In order that changes in operation may be properly justified, some assurance must be had as to the nature of sub-surface conditions. The evidence available on well "A" pointed to the conclusion that maximum production was not being secured. In the first place, the well was not declining in production as fast as similar wells in the same zone. The dynamometer card taken at normal speed was full in shape, with no indication of a fluid pound. Volumetric efficiency was very good, and below-ground efficiency better than average for wells of this depth. Finally, the slow-speed-card figure had upstroke and downstroke loads slightly less than the theoretical, thus comparing with card 5 in Fig. 5.

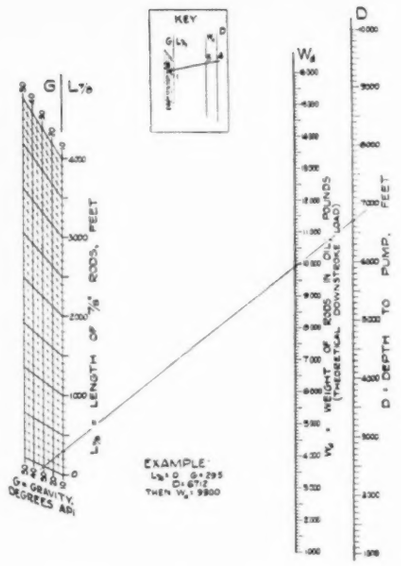


Fig. 11. Weight of rods in oil—7/8-in. and 3/4-in. string

Therefore, it was apparent that production would probably be increased by increasing the displacement. Inasmuch as gas-oil ratio was low and gas anchor of adequate size, it was doubtful if gas would be troublesome. The equipment was under-loaded with the exception of the rod string, the maximum load being excessive for trouble-free operation. If displacement were increased, this condition would undoubtedly have become more acute. However, it could be rectified by tapering the string with 1750 ft. of 7/8-in. rods.

Shortly after this test, the pumping

TABLE 4
Pumping-Well Operation
WELL "C"

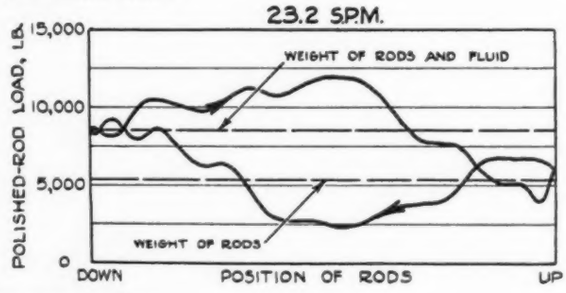
Well
- Present depth, 3,785 ft.
- Liner, 6⅝ in. from 3,681 ft. to 3,785 ft.
- Pump depth, 3,611 ft.
- Pump 2½-in. × 1¾-in. rod, sectional liner
- Sucker rods, 3,592 ft. of ¾-in.
- Gas anchor, outer tube, 2½ in. × 21 ft.
- Production, Gross, 165 bbl.
- Gravity of WET oil, 30.7 deg. A.P.I.
- Gas-oil ratio, 100 cu. ft. per bbl. of oil
- Casing, open to line

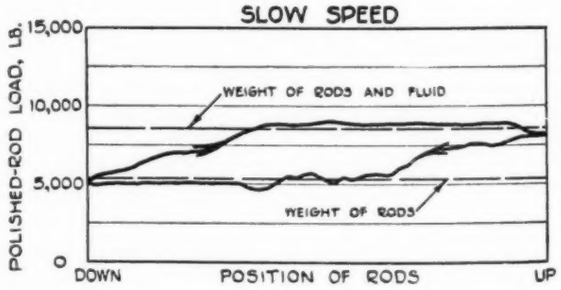
Casing, 9-in. to 3,725 ft.
Perforations from 3,729 ft. to 3,785 ft.
Tubing, 3,611 ft. of 2½-in.
Inner tube, 1¼ in. × 8 ft.
Net, 162 bbl.
Casing pressure, 1 lb.

Rig
- Length of stroke, 49½ in. (4th crank hole)
- Pumping speed, 23.2 strokes per minute
- Pulley diameter, motor, 11¼ in. — Motor end of countershaft, 44 in.
- Bandwheel end of countershaft, 24 in. — Bandwheel diameter, 10 ft.
- Counterbalance, rotary — Number of weights, 8 lead
- Present effective weight, 8900 lb. (A.P.I. rating)
- Theoretically-correct weight, 7000 lb. (calculated)
- Correct weight, 7100 lb. (by dynamometer)

Motor 20- to 50-hp. — Full-load speed, 470 to 970 r.p.m. at 50 cycles.
- Controller point, 6 (8 is wide open)
- Power input, 21.3 hp.
- R.p.m., average, 401 — Motor temperature, 55 deg. cent. — Air temperature, 20 deg. cent.

Dynamometer Cards





Dynamometer Data
- Maximum load, 11,900 lb.
- Minimum load, 2,300 lb.
- Power at polished rod, 11.0 hp.
- Peak torque, 170,000 in-lb.

- Above-ground efficiency, 52 percent
- Below-ground efficiency, 29 percent
- Estimated volumetric efficiency, 47 percent

speed was increased to 22 strokes per minute; since that time, production has been maintained at an average of 175 bbl. gross, 140 bbl. net daily, an increase of about 30 percent. (See Fig. 13.)

OTHER EXAMPLES

Well "B"

Well "B," in the stripper stage, was giving occasional trouble; in nine months there had been two pump repairs or replacements and three rod failures—nothing serious, but subject to improvement. Results of a dynamometer test, given in Table 3, indicated that the well was pumped off. A fluid pound was evidenced on the test card, and volumetric efficiency was low. These conditions could not be attributed to an ineffective gas anchor, inasmuch as the gas-oil ratio was low and the water cut (which tends to break up froth) was high. Rod loads exceeded the theoretical by about 5700 lb. due to dynamic effects of high speed and fluid pound.

Since the excessive displacement appeared to be the main source of trouble, the pumping speed was subsequently reduced to 9¼ strokes per minute by installing an additional 7½-hp. motor and a V-belt drive, using the original 25-hp. motor as a countershaft. This change did not affect production, but reduced the power input 8.2 horsepower. In the nine months of service there have been no rod failures nor pump repairs. As compared with the previous nine months, this amounts to an annual saving of at least $522, as shown in the following tabulation.

Fig. 13. Daily production—Well "A"

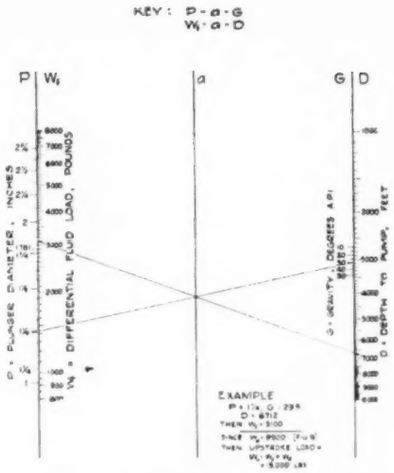


Fig. 12. Theoretical fluid load on plunger

Cost of round-tripping rods, $30 each.

Cost of power, 0.6 cents per kw-hr.

Item	Before Slowing Down, Annual Cost Rate	After Slowing Down, Annual Cost Rate	Saving
Repair rods	$120	0	$120
Repair pump	80	0	80
Power	518	$196	322
Total	$718	$196	$522 = 73%

The total cost of installing the equipment was $285.

Well "C"

Ten days after re-drilling had been completed, well "C" was tested with the dynamometer to obtain general information concerning the rig operation preliminary to a sub-surface pressure test. As shown in Table 4, rig loads were moderate and the counterbalance excessive. However, the important observation was that the shape of the dynamometer card is characteristic of wells not pumped off, having good volumetric efficiencies. As the card was not consistent with the low values of below-ground and volumetric efficiency, computed from test data, leakage was suspected to be the cause. Inasmuch as the slow-speed card indicated that the differential load on the upstroke and downstroke agreed closely with the theoretical, any leakage was probably not in the pump, but in the tubing or the shoe. When the tubing was pulled several days later, the leak was discovered in a tubing collar at 3,036 feet.

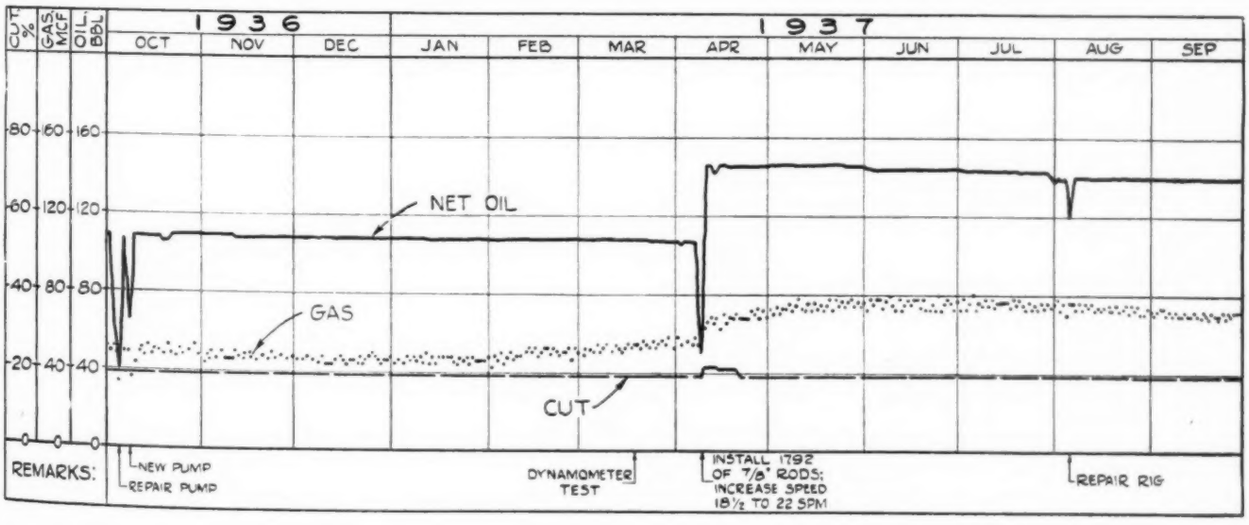
CONCLUSION

Fifteen years' experience has shown that an aggressive policy of dynamometer testing is well worthwhile. Such a policy consists of testing every well as soon as practicable after it has been put to pumping, and again whenever there is any reason to suspect that conditions have changed. Nearly every such test, if properly conducted and interpreted, should lead at least to minor improvements, and a substantial percentage of tests will lead to very important improvements. Benefits include both increases of production and reduced operating cost through elimination of troubles. This paper has outlined the procedure for making and interpreting such tests.

ADDITIONAL REFERENCES

C. J. Coberly, "Problems in Modern Deep-Well Pumping," *Am. Soc. Mech. Eng.*, spring meeting (1938).

B. H. Robinson, "Economics of Pumping," *Drilling and Production Practice*, 1935, 91.



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2. Large, oversize bearings, adequate to withstand the severe shocks of variable pumping loads.
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Recent Progress in the Chemical and Physical Refining of Petroleum Products

By B. KWAL

Part I

Purification of Gas

IN the raw state all petroleum products contain different undesirable compounds. Free sulphur in petroleum products cannot be tolerated because of the serious corrosion problems that would result. Natural gas and refinery gas may also contain hydrogen sulphide that must be removed. The removal of hydrogen sulphide and other sulphur compounds from fuel gases is very important in the natural gas industry, refining, and the manufacture of carbon black. The new methods of manufacture of gasoline and other products by means of polymerization and hydrogenation do not permit the use of gaseous hydrocarbons containing sulphur compounds because the presence of such gases in the cracking apparatus is harmful to the equipment. Gas containing even small amounts of hydrogen sulphide will not produce carbon black of high quality. Therefore, the purification of the gas is among the most important problems in the utilization of refinery gases as well as of natural gas.

There are many methods of removing hydrogen sulphide from gas, the iron oxide process being the oldest. In this process the hydrogen sulphide reacts with iron oxide to form ferrous sulphide and water. The reaction between hydrogen sulphide and iron oxide evolves a great amount of heat. Therefore, if this process is used for the removal of one percent hydrogen sulphide from a gas the heat of this reaction is so great that spontaneous combustion may occur in the contactor. This phenomenon caused the complete destruction of an iron-oxide gas-treating plant in West Texas in 1927. This process, therefore, is unsuitable for purification of gases rich in hydrogen sulphide. Besides, the process has other disadvantages. Excessively large contactors are required because of the fact that the iron oxide must be nearly dry to prevent caking and hence large surfaces coated with very thin layers of the oxide are needed to obtain proper contact with the gas. Furthermore, large areas are required for aerating the spent treating material. To regenerate the used iron oxide the mixture is exposed to the action of air. The oxygen of the atmosphere reacts with the ferrous sulphide, precipitating sulphur, thus regenerating iron oxide. Furthermore, while the trays in the contactors are being changed relatively large amounts of air are unavoidably admitted and sometimes this air in the gas causes violent explosions. This process, therefore, presents neither economic nor technical advantages.

Petroleum technologists have been seeking a method that would avoid these inconveniences. The use of iron hydroxide in suspension in water has been proposed. The foul gas is passed through this liquid and the reaction between hydrogen sulphide and iron hydroxide takes place directly in the liquid. The spent liquid is then blown with atomized air to oxidize the ferrous sulphide to iron hydroxide.

Michael J. Leahy has stated that in practice the iron sulphide is oxidized completely to iron oxide and precipitates. Also, he found that the cost of the iron hydroxide was greater than that of an equivalent quantity of bog-iron ore. Although the temperature of the reaction can be controlled to some extent, much water is necessarily vaporized, and this steam later must be removed from the gas to prevent condensation in the mains and holders. Leahy has studied this process and found it unsuitable for the purification of gases for the following reasons: cost of equipment is high, power cost is high, and the volume of air required for oxidation of the spent suspension is three to eight times the volume of gas treated.

In 1911 Walter Feld developed a process for removing hydrogen sulphide from gases by means of soda-ash solution. Many patents pertaining to this method have been obtained, the best known of these being the Seabord process. This is a continuous, cyclic process in which a solution containing five percent soda ash is used in a packed tower to wash the hydrogen sulphide from the gas, and is then regenerated by blowing with air in a similar tower. The solution is then reused for absorption of hydrogen sulphide.

This process, however, shows good results only when the gas contains small amounts of hydrogen sulphide. If gases of high sulphur content are treated by this process the rate of circulation of the solution must be very high, the amount of air required to blow the fouled solution is extremely high, and the amount of fresh soda ash that must be added to the solution to maintain its efficiency is excessive.

Hydrogen sulphide dissolved in the solution shows a tendency to escape when the solution is being regenerated. The vapor pressure of hydrogen sulphide in the solution depends upon the quantity dissolved in the solution, upon the strength of the solution, upon the sort of reagent, and upon the operating temperature. As hydrogen sulphide is absorbed from a gas by a solution, the vapor pressure of the hydrogen sulphide increases with the increase in concentration until it equals the partial pressure of the hydrogen sulphide in the gas. When that condition is reached the hydrogen sulphide will be returned from the solution to the gas as fast as it is absorbed, so that there can be no further increase in the concentration of hydrogen sulphide in the solution. When the foul solution is heated to boiling, the vapor pressure of the hydrogen sulphide increases, and the gas is rapidly volatilized. This continues until the partial pressure of the hydrogen sulphide in the steam is equal to the vapor pressure of that in the foul solution on the top plate of the still. This is the maximum concentration that the steam will carry. Because the steam as generated contains no hydrogen sulphide, it is theoretically possible to reduce the vapor pressure of hydrogen sulphide in the solution to zero, but in operation this state cannot be attained, and the clean solution leaving the still has a small hydrogen sulphide vapor pressure, which is lowered quantitatively when the solution is cooled. The hydrogen sulphide vapor pressure of

the cold, clean solution obviously determines the minimum concentration below which it is impossible to reduce the hydrogen sulphide content of the gas. Therefore, enough steam must be generated in the still to clean the solution sufficiently that the gas can be adequately purified. Not only soda-ash solution but also sodium carbonate or ammonia can be used to remove hydrogen sulphide from gases, however. The reagents may be divided into two classes: the first class includes weaker bases, such as magnesium hydroxide, calcium hydroxide, ammonium hydroxide, and the alkali salts formed by the union of one of the strong bases with a relatively weak acid; the second class includes the strong bases. The weaker bases enter directly into chemical reaction with hydrogen sulphide forming sulphide or hydrosulphide salts, all of these sulphides being readily decomposed by boiling, resulting in regeneration of the original solution and evolution of hydrogen sulphide. Strong bases react with hydrogen sulphide to form first the sulphide and then, with more hydrogen sulphide, the hydrosulphide. When these hydrosulphide solutions are boiled a large amount of the NaHS will be converted to sodium sulphide, but it is only with the greatest difficulty that the sodium hydrosulphide can be completely decomposed.

Let us now consider the process of absorption of hydrogen sulphide by sodium carbonate. When hydrogen sulphide comes in contact with a sodium carbonate solution, sodium acid carbonate and sodium hydrosulphide will be formed. When the foul solution is boiled the decomposition of the compounds results in splitting of the carbon dioxide from the acid carbonate and the removal of hydrogen sulphide. The original solution could be obtained if there were no loss of carbon dioxide along with the hydrogen sulphide. As a result of this loss not all sodium sulphide will be decomposed, so that always new molecules of sodium carbonate will be converted to sodium sulphide. Thus, according to P. J. Wilson, jr., a solution containing 100 g. per l. of sodium carbonate at the start may, after repeated contact with a gas containing 3000 grains of hydrogen sulphide per 100 cu. ft. and more than two percent carbon dioxide, carry 2000 grains of hydrogen sulphide per gallon. If the sodium carbonate were all converted to sodium sulphide, the solution would contain about 1800 grains of hydrogen sulphide per gallon. Therefore, in addition to the sodium sulphide some sodium hydrosulphide is obviously present.

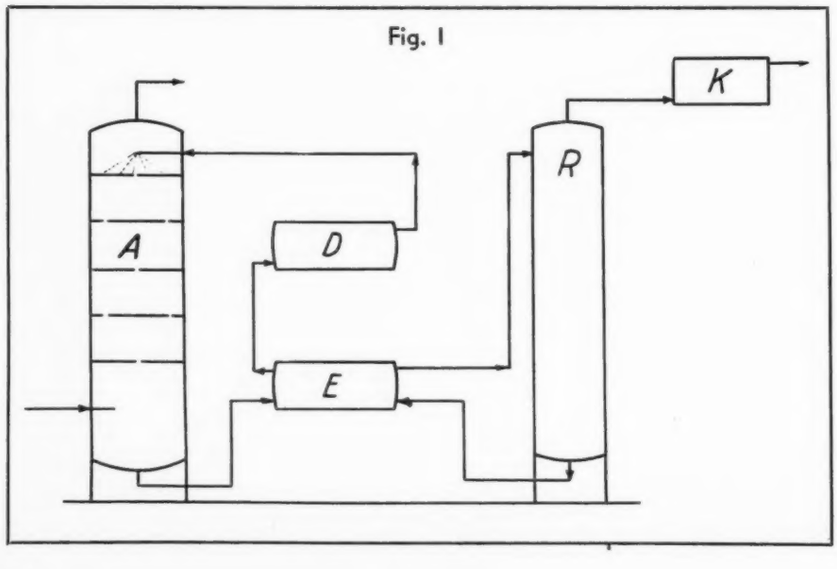
It must be mentioned that natural gas and refinery gas contain carbon dioxide in different amounts. This compound reacts with all absorbents used in the absorption of hydrogen sulphide, forming carbonates. Consequently, when the carbon dioxide is removed by the same absorbent, less hydrogen sulphide will be absorbed. Less hydrogen sulphide per gal. means a larger volume of solution to be circulated, and more solution in turn requires more steam for boiling. Hydrogen sulphide and carbon dioxide are not absorbed at the same rate by all reagents. Some will absorb as much carbon dioxide as hydrogen sulphide, so the volume of solution necessary to purify a given volume of gas and the quantity of steam required to regenerate the absorbing solution will be doubled. Other reagents will remove nearly all the hydrogen sulphide from the gas before absorbing an appreciable quantity of carbon dioxide, and the quantities of solution and steam needed will not be greatly affected by the presence of carbon dioxide in the gas.

The industrial operation of removing hydrogen sulphide by means of the above-mentioned reagents is the same. The gas containing hydrogen sulphide is directed to the absorber tower A where it flows from the bottom towards the top. (Fig. 1.) The regenerated solution passes through a heat exchanger E, and the cooler D, thence to the top of the tower A. In this absorber the hydrogen sulphide is scrubbed from the gas by means of the solution, which falls countercurrently to the bottom of the tower. The foul solution leaves the absorber and passes through the heat exchanger E to the top of the still R, in which it is regenerated by boiling with steam. The regenerated solution, that is, the solution free of hydrogen sulphide, is cooled and returned to the absorber tower A. The steam containing hydrogen sulphide rises to the top of the still R from which it passes to the condenser K. In this condenser the steam is condensed and the hydrogen sulphide separated. The hydrogen sulphide can be recovered in a very concentrated form.

A very interesting and economical method is the process patented by Girbotol for the purification of petroleum gases. The Girbotol purification process is based upon the discovery that aliphatic amines have a strong affinity for acid gases such as hydrogen sulphide and carbon dioxide at or near atmospheric temperature, but at higher temperatures the affinity decreases rapidly and the gas is expelled. This characteristic makes it possible to operate the process in a continuous cycle, absorbing acid gas at atmospheric temperature and expelling it at another point by raising the temperature of the absorbent. The amines are strong bases, soluble in water, therefore several volumes of acid gas may be removed per volume of solution circulated.

It is important to mention here that hydrogen sulphide reacts with amines to form sulphides, which react with additional hydrogen sulphide to form the hydrosulphides, which are readily decomposed. Of course, the apparatus illustrated in Fig. 1 can be used in the Girbotol process. Gas to be treated flows up through the absorber. Amine solution, at atmospheric temperature, enters the absorber and flows down the tower from tray to tray absorbing the acid. Purified gas leaves the absorber at the top. The amine solution, which is saturated with the gas, is directed to the heat exchangers, where it is raised to a temperature of 200 deg. fahr., and then into the upper part of the reactivator, which consists

Fig. 1



FITS LIKE A GLOVE

THEY decided to open up one of the upper sands—but there was water above and below. So they shot 'em both, and set the cementing-tool between them.

Then, in 2 hours and 35 minutes, 60 sacks of 'Starcor' were squeezed through perforations below the tool. Next, they closed it, backed off, and in 30 minutes squeezed 20 sacks through perforations above the tool. Pretty conclusive proof that 'Starcor' stays pumpable plenty long to do any Squeeze Job!

Three days later, they drilled out, shot the sand and got pipe-line oil without a drop of water. Another reason why Oil Men say: " 'Starcor' fits these Squeeze-job problems like a glove." You'll say the same thing, if you'll try 'Starcor' next time.

Use 'Starcor'*, also, for deep wells, high temperatures, extra sulphate resistance. 'Incor'* for wells of moderate depth. Lone Star for construction work above ground. Portland cements, all—each the quality standard-bearer in its own field.

*Reg. U.S. Pat. Off.

TWO PORTLAND CEMENTS—BOTH MADE FOR OIL WELLS

USE 'STARCOR'—for deep wells, high temperatures, extra sulphate resistance.

USE 'INCOR'—for wells of moderate depth, and low temperatures.

of a bubble tower containing in its base a tubular reboiler section and at the top a reflux condenser. Now, the amine solution, falling down the tower, is heated to a temperature of 220 deg. fahr. by steam rising from the boiling solution in the reboiler section and the gas is expelled and flushed out by ascending vapors.

The gas leaving the reactivator is saturated with water vapor at a temperature of 200 deg. fahrenheit. It flows through the condenser where it is cooled by water and the steam condensed. The condensate is returned to the reactivator. Hot solution stripped of gas is pumped from the base of the reactivator through the exchangers and water coolers, and finally back to the top of the absorber.

The gas in the Girbotol purification process may be treated at high or low pressure with the same success but gas under pressure is purified more economically because smaller towers are required and larger volumes of hydrogen sulphide are removed per gal. of solution circulated. It must be mentioned here that this process is well adapted for purifying gases containing a large percentage of hydrogen sulphide.

Leahy (U. S. P. 1,800,892; 1,812,795; 1,995,545; and 2,026,840) has proposed a method in which hydrogen sulphide is absorbed in water, to which is then added sulphur dioxide to form free sulphur, finely divided and held in suspension. Leahy devised this method after experimenting with the use of a solution of sulphurous acid for the absorption of hydrogen sulphide from natural gas. This experiment convinced him that the proper procedure was to reverse the cycle, proceeding as outlined above. Further experiments of Leahy showed that the sulphur in suspension could be flocculated and rapidly precipitated by the addition of certain electrolytes. He proposes the flocculation of the sulphur by addition of a certain class of soluble electrolytes, which are thereafter removed. The solution is regenerated by addition of a second class of electrolytes, and in this condition it can be recycled indefinitely. The process is being used to purify a West Texas gas containing 9.2 percent hydrogen sulphide.

The operation of this installation is as follows: the untreated gas enters the plant at a pressure of 30 lb. per sq. inch. The pressure of the treated gas is about 21 lb. per sq. inch. In order to treat the volume of gas, solution is circulated at the rate of 150 gal. per minute. About 200 gal. per day of make-up water is required. No steam nor other means of heating is used in this process because it has been found unnecessary. The sulphur dioxide necessary for the process is obtained by burning sulphur in a pressure-type sulphur burner. The hot gases are immediately mixed with the foul solution and the temperature of the solution is thus maintained practically uniform at 85 deg. fahrenheit. If this process is operated for the production of pure sulphur as a by-product, the treating solution will last indefinitely, and therefore the cost of chemicals is very small. If prepared fungicides, fertilizers, or insecticides are being produced as by-products, addition of the proper electrolytes to the solution is necessary in order to keep the solution fully concentrated and to provide for replacement of the prepared compounds, which are continuously separated from the treating solution. It must be admitted that this process is an economical method, peculiar in that no heating or cooling is necessary during the operation. Furthermore, no air is needed for regeneration of the foul solution, and no hydrogen sulphide is released to the atmosphere to create a nuisance. A variation of the procedure is given by Kuhl (U. S. P. 2,028,336) in which the gas is mixed with NH_3 or SO_2, and after this operation the gas is passed through water.

A very interesting method of removal of hydrogen sulphide from gases is the Phenolate gas purification process. (U. S. P. 1,971,798; 2,002,357; 2,028,124; and 2,028,125.) This process consists of an absorption stage and an actification stage, through which the phenolate solution is circulated continuously. This solution has an extremely high carrying capacity for hydrogen sulphide, 2000 to 4000 net grains per gallon. As a result, it is necessary to circulate only five to ten gal. of solution per M. cu. ft. of gas. This very low rate of circulation is one reason for the low operating expense and the small size of equipment required in comparison to other purification processes.

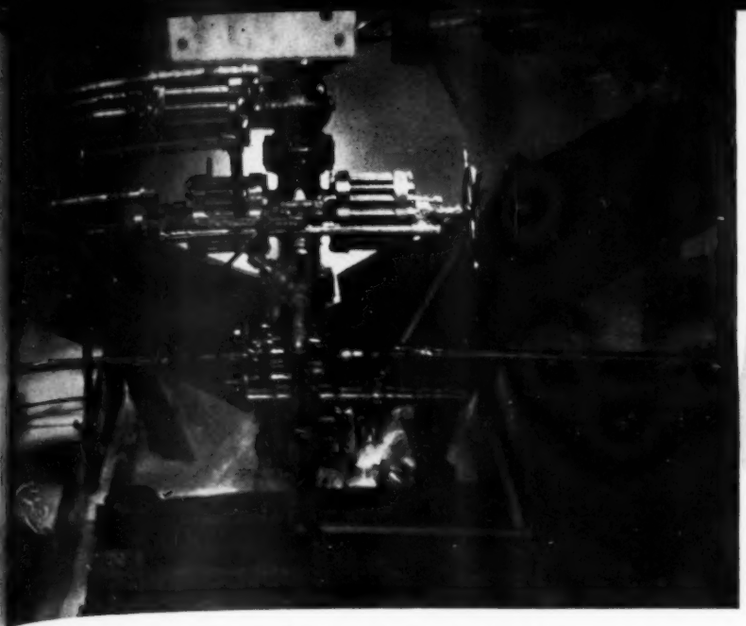
The industrial operation of this system is as follows: the gas containing hydrogen sulphide is directed to the base of the absorber, passes upward through the bubble-cap trays, and leaves at the top, 95 percent of its hydrogen sulphide having been absorbed. The solution leaving the bottom of the absorber, saturated with hydrogen sulphide with respect to the incoming gas, passes through a heat exchanger to the top of the tower, called the actifier. The solution flows downward over the actifier trays, countercurrent to the stripping steam, which is generated in the reboiler in the base. Sufficient indirect steam is used to effect the desired degree of actification of the solution. The actified solution flows from the reboiler through the heat-exchanger and is further cooled in the solution cooler. The cooled solution is ready for further absorption and is pumped to the top of the absorber. The hydrogen sulphide removed from the phenolate solution in the actifier passes from its top to a dephlegmator where steam is condensed to water and the hydrogen sulphide in concentrated form can be directed to the acid plant burner or other point of disposal. The phenolate solution used in this process is a mixture of caustic soda and crude phenol, the chemicals required for the process being therefore inexpensive.

A phenolate solution obtained by treating a shale tar fraction boiling between 200 and 300 deg. cent. with caustic soda was used by Dobriannski (Goryuchie Slantzui, 1935, 42) to remove hydrogen sulphide and carbon dioxide from gas from shale retorts. Because the hydrogen sulphide was absorbed three times as rapidly, it was possible to separate these gases by adjusting the gas velocity and installing a scrubber for the carbon dioxide.

The gas can also be purified by the Thylox process (Ind. Eng. Chem., 1934, 130). The removal of hydrogen sulphide by this process depends on the absorptive power of an aqueous solution of sodium or ammonium thioarsenate. According to Gollmar, this solution is able to absorb hydrogen sulphide quantitatively. Referring to the flow diagram, the gas enters the absorber at the base, encountering on its way upward the aqueous solution of sodium or ammonium thioarsenate. The foul solution is directed to the actifier, where it is regenerated by absorption of oxygen, which replaces and precipitates the sulphur in elemental form.

Sulphur compounds can be removed from gases by circulation through an aqueous solution or suspension of a metal oxide, hydroxide, or carbonate (Engl. P. 407,040) and free sulphur recovered from the spent solution by aeration, simultaneously regenerating the solution.

In the purification of gases it can be seen that the industrial operation of all methods is similar, and the flow diagram of all methods resembles Fig. 1, a different absorbing solution being used in each of the above proposed patents. Of course, the most important problem in these purification processes is the construction of apparatus that is resistant to corrosion.



View of Cameron high pressure control hookup below derrick floor on State Lake Long No. 4. All Cameron control units held perfectly under pressure. Loss of control was due to a leaky flow line valve of conventional design installed on a flow line opening of the 7" Cameron type "SDA" Blowout Preventer.

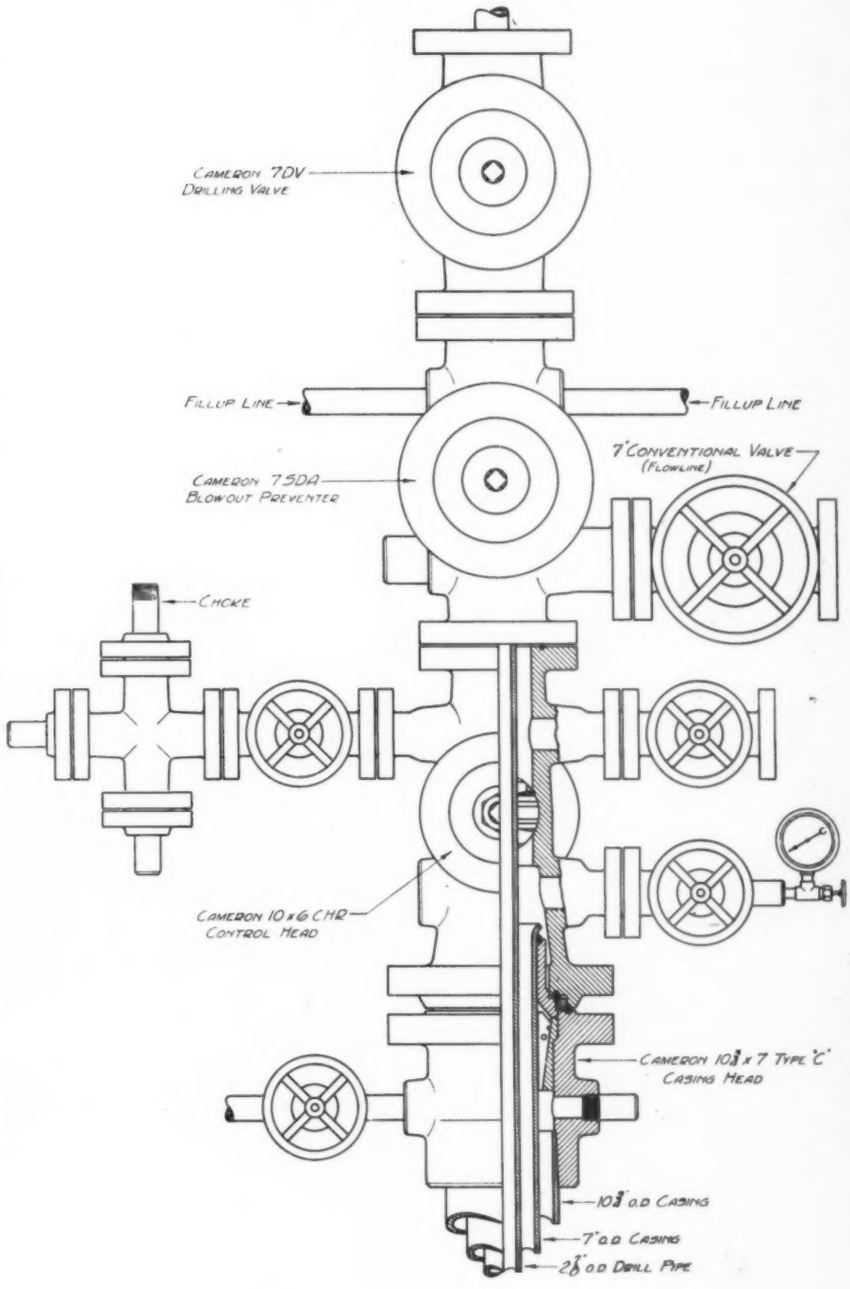
RAM TYPE
Tubing Head Controls 10,200 Foot Well After 4 days of Blowing Wild!

While preparing to test oil string on Fohs Oil Company State Lake Long No. 4 recently, the well kicked at the surface for reasons unknown. Cameron 7" type "SDA" Pressure Operated Blowout Preventer was immediately closed around 3½" OD drill pipe. As well pressure built up, a 7" conventional gate valve on flow line opening below the rams of preventer began to leak. Before well could be killed, valve cut out beyond control. A heavy cloud of gas between the derrick floor and the drilling barge made working almost impossible. After four days of blowing, the conventional flow line valve was so badly cut it became possible to pull it off with a chain block. This released full flow of well outside of derrick floor, and relieved gas condition below derrick floor.

Meanwhile, a Halliburton high pressure cementing barge, loaded with weight material, was spotted near the derrick. A Cameron 7" type "MP" Blowout Preventer, with O-C-T stripper type control head above, was installed on a nipple made up in top flange of 7" Cameron Pressure Operated Master Gate Valve on drilling-in hookup. This permitted connection of a joint of 2⅞" OD drill pipe to the 3½" OD drilling string.

With 2⅞" OD drill pipe opposite the rams of the Cameron type "6-CHR" Tubing Control Head (see drawing to right), assembled with rams closed on 2⅞" OD tubing, it was possible to close these rams around 2⅞" OD drill pipe. This shut in and sealed the annular space between drill pipe and 7" oil string, below 7" Cameron type "SDA" Blowout Preventer. Heavy mud was promptly pumped in by Halliburton cementing barge crew and well was successfully killed.

In that a Cameron Ram type "CHR" Tubing Control Head saved possible loss of a 10,200 foot hole; the expense incident to killing the well the "hard" way; the necessity of floating the drilling barge from over the well, thus making capping operations doubly difficult; and the possible loss of a $250,000 barge drilling outfit, it more than earned its slight extra cost over less positive and dependable Christmas-tree control units. Operators drilling deep wells in high pressure areas, or deep wild-cats in any area, should have all the facts regarding the latest types of Cameron drilling, drilling-in and completion control equipment. They will gladly be provided without obligation.



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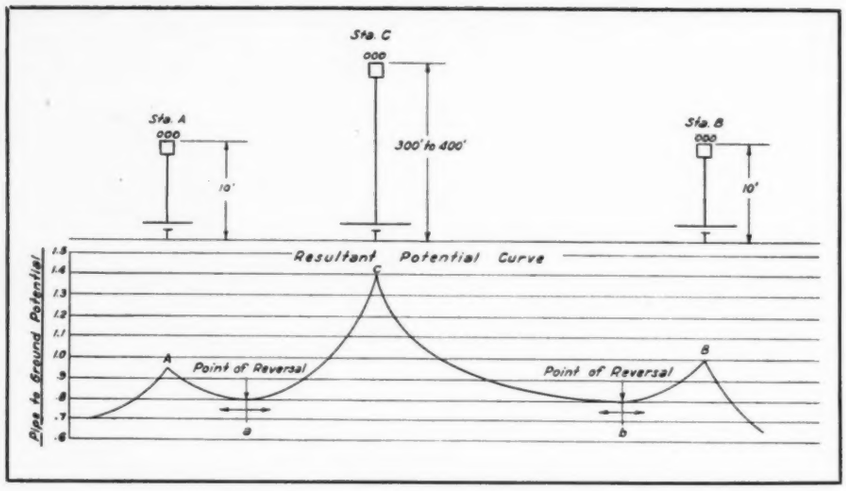


Fig. 1. Diagram showing station locations

By

S. U. McGARY

Engineer, United Gas Pipe Line Company

Determining Location and Capacity of Units for Cathodic Protection of Pipe Lines

The manner in which joints are connected determines procedure to follow in making tests to decide upon size and location of units

THE feasibility of cathodic protection of pipe lines as a means of arresting corrosion depends largely upon the capacity and location of the protection units.

Type of Construction

The manner in which the joints are connected determines the procedure to be followed in testing for the purpose of deciding upon size and location. When the lengths of pipe are joined together by mechanical couplings, each section of pipe is insulated to some extent from the adjacent sections. It is therefore impossible to ascertain the location or extent of "hot spots" by measurement of long-line currents. Other types of joints, such as screw-coupled or welded, form a continuous electrical conductor of uniform resistance, and permit the use of long-line currents for this purpose.

Mechanically Coupled Lines

When mechanical couplings are used at joints, leak records, if available, will be of value in locating the areas where the severest corrosive attacks have been experienced. In order to determine the extent of "hot spots" the pipe within the area indicated should be inspected at regular intervals. Soil resistance measurements, together with soil type examinations, are also valuable for this purpose. The condition of the coating and the pipe-line soil contact area should be observed also, as these two factors greatly influence the amount of electrical energy needed to protect the section. A soil survey will aid in ascertaining which sections of pipe are laid in the most corrosive soil.

Before it is possible to attach a test unit to a section of such line it is necessary to braze a copper wire around each mechanical coupling, which can be done while the line is in service. This provides a continuous path for the flow of electrical current. Each coupling in the section to be protected must be bridged with a large-size copper wire.

The section is then ready for a preliminary test with a portable source of electrical power. For very large-diameter lines when the coating is in poor condition and the soil contact with the pipe line is high it is necessary to use a unit capable of draining at least 50 amp. from the line if as much as one-half mile is to be tested. The negative wire of the test unit should be attached to the middle section of the line exposed to the soil of highest corrosivity. A temporary ground bed is installed by using a few joints of junk pipe in a shallow trench. Before any power is applied, the potentials of the line through the section to be protected are taken. The power is then supplied at a constant rate and the potential of this same section of line is measured. The area between the two curves represents the potential change of this section of line due to the applied electrical drain. On the same diagram the area necessary to protect a certain amount of pipe may be ascertained by a comparison of the two curves. It will then be possible to determine the number and capacity of units required to protect a given length of pipe line.

Welded and Screw Construction

When the mechanical coupling type of joint is used current does not go far beyond the point where the couplings cease to be bridged with a conductor. For all practical purposes the area tested is the area where the couplings have been bridged. On a welded or screw-coupled line, however, there are no insulating joints in the line to prevent the current from flowing an indefinite distance along the pipe line, and it is impracticable to place a temporary insulating flange in the pipe line to prevent this condition.

The only satisfactory method for testing is electrical blocking. This method is illustrated in Fig. 1, in which three units are used. The two units, Station A and Station B, are of small capacity and current is supplied by a

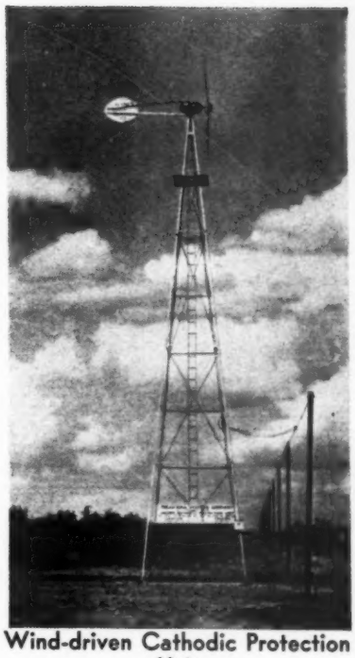
storage battery or a car generator. The generating equipment at Station C, if the pipe line is almost bare, has at least 50 amp. capacity at 50 volts. The positive terminal of each of the units is improvised and consists of junk iron in contact with moist salty soil. The ground beds of the blocking units A and B are only about ten ft. from the line, whereas the last unit C is at least 400 ft. away. The blocking units are started and regulated so as to drain five or six amp. from the pipe line at this point. The testing unit at C is now started and regulated so as to produce a potential on the line between the points A and B. The points of reversal, (a) and (b), are found by current measurements on the pipe line. The points (a) and (b) have the same effect electrically as if an insulating coupling were installed in the line at these points. The distance between the points (a) and (b) represents the amount of line the potential of which has been changed by the current flow from Station C. The estimate of the amount of pipe protected is made in the same manner as for a section of a mechanically-coupled line as previously discussed.

A potential far greater than the amount necessary for protection is created at the point where the ground bed wire is attached to the pipe line when a single ground bed is used. All current above the amount required for protection is wasted energy. In the permanent installation considerable electrical energy can be saved if two split ground beds are installed instead of a single one. Fig. 2 shows the results of a typical installation. The single ground bed provides an area over which the potential reading is very high, causing a great waste of electrical energy. By the use of two ground beds this energy is better distributed and there is a much smaller loss of power. The split ground bed has the same effect as the installation of two small units.

Conclusion

There are so many factors that influence the quantity of electric current that must be drained from a pipe line in order to protect a certain section that it is difficult to estimate the amount required without knowing all or most of them.

The kind and condition of the coating is one of the influencing factors. The soil contact at bare places is another item affecting current requirements. Some soils have the property of adhering tightly to the pipe whereas others touch the pipe at only a few points. Some soils have high resistance and are not corrosive, and thereby offer a medium of resistance. A paper wrapping may stand away from the pipe, providing an air gap between the coating and the pipe. These are some of the factors that influence the amount of current necessary to protect any section of pipe. Very probably there are others that are unknown at present. In order to ascertain the number and size of units required it is necessary that this type of test be performed on any section of line where installation of cathodic protection is contemplated.



Wind-driven Cathodic Protection Unit

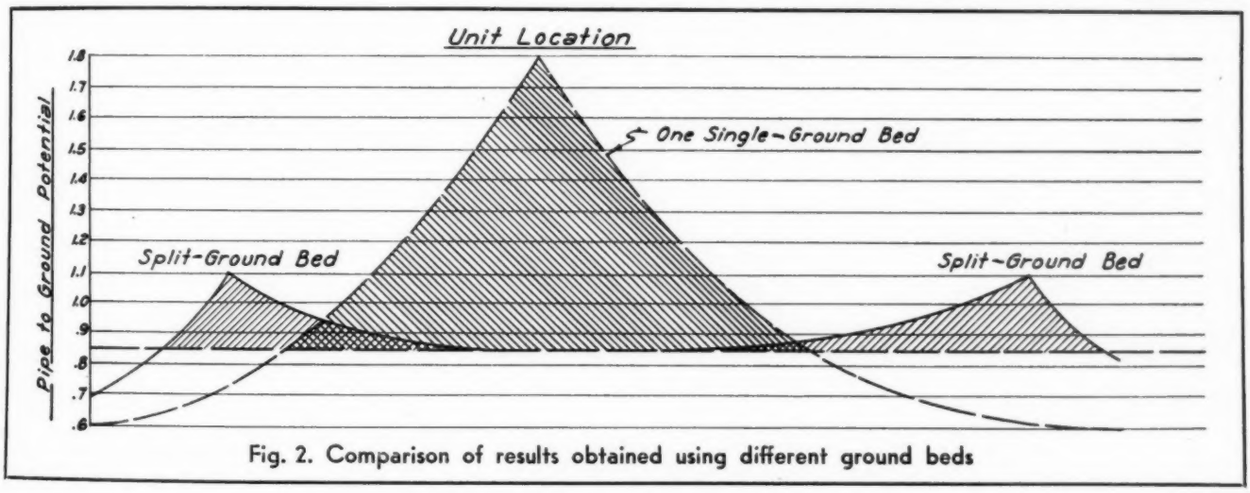


Fig. 2. Comparison of results obtained using different ground beds

"Nitrogen-Reduction Ratio"

"Nitrogen-reduction ratio" is the scientists' name for the result of two tests for locating oil in advance of drilling. It is the ratio between the amount of nitrogen in an oil sediment and its chromic acid requirement, which purports to show when and where oil exists.

Experiments in the California, Rocky Mountain, Mid-Continent, East Texas, and Gulf Coast fields show that oil is present in large quantities where the sediments have a low nitrogen-reduction ratio. If samples show a high nitrogen-reduction ratio, it means, presumably, that the strata do not contain oil-building materials.

In one area, samples from a well located on a structure similar to other structures found productive in the past showed a high ratio. Drilling continued, but the well was dry. Leases slated for purchase in the vicinity of the well were cancelled—at a saving of $100,000.

The Use of Small Units For Electrical Protection of Pipe Lines

When rectifiers are used and electric power is obtainable at short intervals along the line the small cathodic protection unit is recommended

By STARR THAYER

Corrosion Engineer, Houston, Texas

THE art of electrically protecting pipe lines is no longer new. It has been several years since the first pipe line was so protected. The application of this protection has extended to almost every state in the Union in which there are pipe lines, and the method is being used to some extent by almost every major pipe line company in the country. So much has been published on this subject that it will not be necessary here to go into the details or merits of this method of protecting pipe lines. The question regarding whether or not a pipe line can be so protected is no longer debatable. The experience of many years indicates beyond all doubt that pipe lines can be freed from corrosion. The work of protecting pipe lines has now reached the stage where the question is asked, "How much will it cost?" rather than, "Can it be done?"

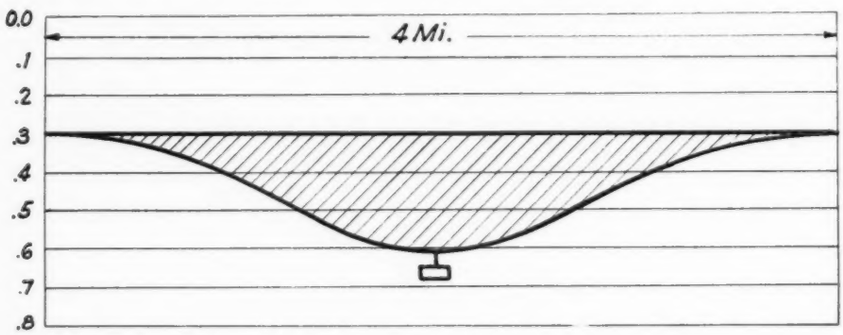


Fig. 1

Present Equipment

As in the last several years, and probably for some years to come, the chief concern of the engineer in applying this protection is the type and size of generating equipment. The first units installed were the rectifier type where power was purchased and then rectified and applied to the pipe line. This equipment is still generally used where a source of power is available. Windmills have been used in various sizes. Engine-driven units have been used by several companies, especially on gas lines where fuel could be taken from the pipe line. Many rectifier stations have been installed where considerable current was used on the line, sometimes as much as 100 amp. in one station. The writer has seen windmills develop an excess of 100 amp. when wind conditions were favorable. Engine-driven generators have been used, and as much as 200 amp. generated in a single unit.

It is not the purpose of this article to discredit large installations, for it will be found that in many instances the large installation is the most economical and practicable to use; however, the use of smaller units, wherever practicable, should be considered. This is best illustrated by the accompanying curves.

Fig. 1 illustrates an installation in which 41 amp. was being applied to the pipe. The heavy straight line across the curve indicates the protection voltage that is necessary to preserve the pipe. It is seen that in order to protect the pipe at the ends of the area where the protection is desired, it is necessary to apply much more than the requisite amount in the area nearer the station. This potential, which is shown by the shaded area, represents wasted power. Nothing is gained by applying more protection to the pipe than is necessary to stop corrosion. Now, if this same area of line were to be divided and each half of it protected by a unit, the results would be as shown in Fig. 2.

The amount of shaded area in Fig. 2 is seen to be very much smaller than the shaded area in Fig. 1. How much smaller it is, is best indicated by the following data:

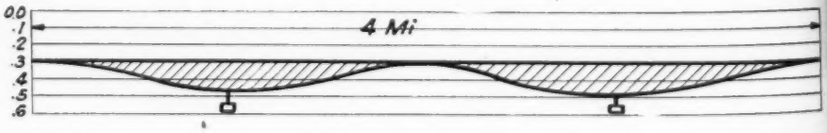
The protection unit in Fig. 1 was using 41 amp. at 10 volts, or 410 watts. Each of the units in Fig. 2 was using 15 amp. at 1½ volts, or 22½ watts, a total of 45 watts for the entire area.

Fig. 3 illustrates an installation where a unit was operating at 80 amp. and 10 volts. In this graph, it is seen that the pipe line, which was a large, bare line, was not completely protected for a mile, but for the purpose of illustration we shall assume that it was completely protected.

In Fig. 4 is illustrated the effects of a small unit generating 8 amp. at 1½ volts, and which is protecting approximately a quarter of a mile on this same pipe line. The large unit was protecting a mile of pipe using 800 watts. To protect this same mile of pipe, four of these small units would require a total of 48 watts.

The conclusion to be drawn here is that use of the small units will result in a tremendous saving of power; however, one should not blindly say that the small unit is the thing to use.

Fig. 2



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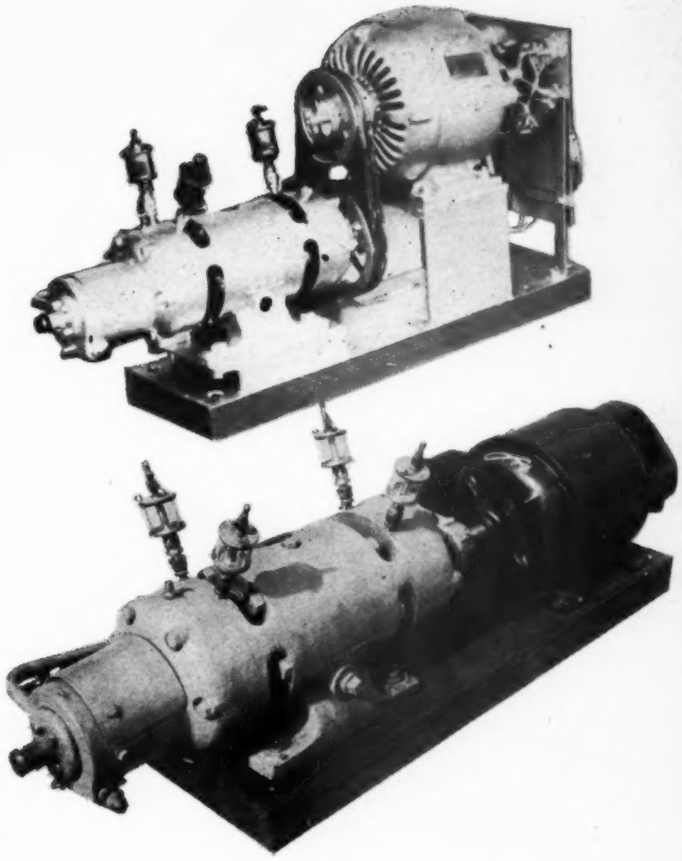

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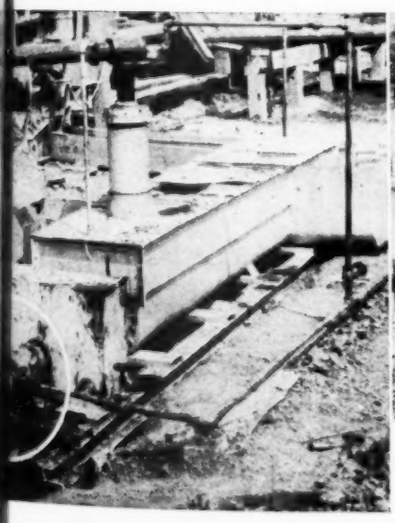
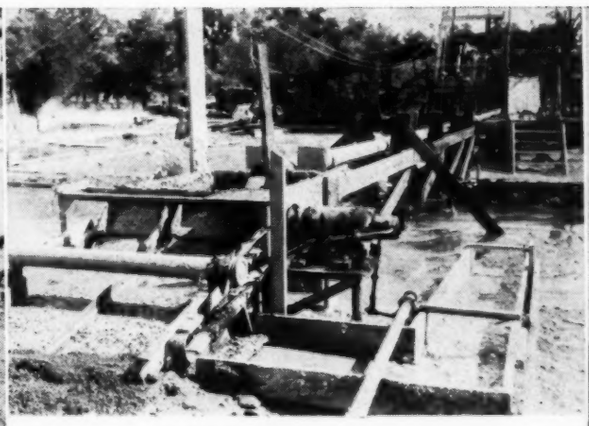
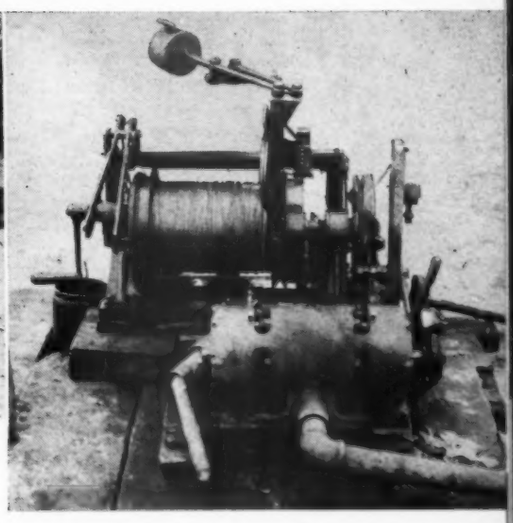


MUD DEGASSER UNIT — GULF COAST



SHALE SHAKER UNIT INSTALLATION IN OKLAHOMA



MEASURING LINE REEL INSTALLATION IN LOUISIANA

REED ROLLER BIT COMPANY

P. O. DRAWER 2119, HOUSTON, TEXAS

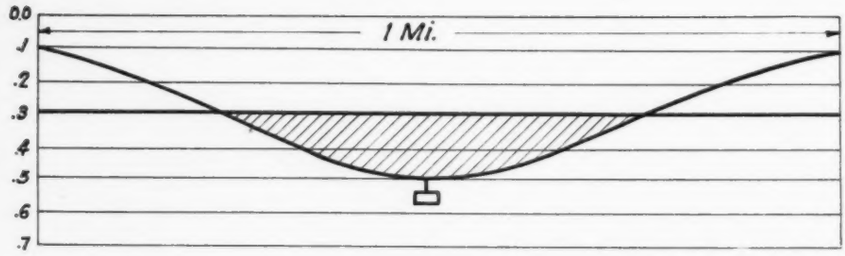
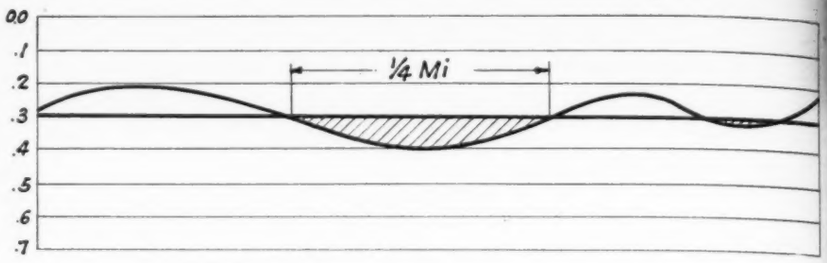


Fig. 3

There are factors other than the saving of power. For instance, it is not probable that an engine much smaller than the ones now being used could be operated satisfactorily and if it could be the first cost probably would not be much less than that of the larger engine.

It is obvious, therefore, that where this type of unit is used, there is a definite minimum limit to its size. Where rectifiers are used, and where power can be obtained at short intervals along the line, there is no doubt that the small units should be used. Where power is not available, it is possible that the heat generator, which is now being offered by one manufacturer, may be practicable. This unit has no moving parts, nor any of the objections that might be encountered in a very small engine unit. The cost of installation of these smaller units should be much less than that of the larger units. No attempt would be made to protect any very great length of line with the smaller units; and therefore, the ground bed could be relatively close to the line and could be very small.

Fig. 4



Flow Characteristics, Composition, and Liquid-Phase Properties of Hydrocarbon Fluids from a "Combination" Well

PRELIMINARY results of a study of the phase relations of fluids in a deep high-pressure, high-temperature reservoir of gas and light gravity hydrocarbon liquid were discussed in a report made public by the Bureau of Mines, Department of the Interior, at the convention of the Natural Gas Department, American Gas Association, in New Orleans, Louisiana. A study of well performance and liquid recovery at several rates of fluid delivery, and analyses and measurement of physical properties of fluid samples taken under stabilized conditions of pressure and flow gave the data essential to the investigation.

Knowledge of the phase relations of the fluids that exist in the porous spaces of rocks constituting natural petroleum reservoirs and of the behavior of these fluids under various field conditions of operation is essential to the conservation of petroleum and natural gas and to their efficient recovery. The problem of determining whether these fluids are in the liquid or gaseous state and of recognizing the transitions that may take place as the material in the reservoir is subjected to different conditions of pressure and temperature confronts many producers today, especially in certain fields. The subject has grown rapidly in importance since the discovery of deeper reservoirs that have correspondingly higher pressures and temperatures as compared with shallower producing zones.

In the course of the tests made by the Bureau of Mines, surface samples of hydrocarbon liquid and gas were taken at the separator under conditions of stabilized flow for re-mixing in the proportions of the measured ratio of gas to hydrocarbon liquid to provide a system on which phase relations at reservoir and flow-string pressures and temperatures could be determined. A subsurface sample of hydrocarbon liquid from the well bore provided a liquid phase that in composition and properties closely approximated a liquid that could originate in the reservoir.

Although comparison of the gas-hydrocarbon liquid ratios of the well under several rates of fluid delivery did not indicate conclusively the presence of a hydrocarbon liquid phase in the reservoir, the field tests showed that hydrocarbon liquid was present in the well bore while fluid was being produced from the well.

It was concluded that part of the fluid recovered from the well was present in the reservoir in the liquid phase, and the remainder was formed during the process of production by condensation of heavy components from the original reservoir vapor phase.

The report, containing several graphs and tables that should assist engineers in developing further knowledge on this important practical problem of operation, has been published as Report of Investigations 3402, Flow Characteristics, Composition, and Some Liquid-Phase Properties of Hydrocarbon Fluids from a "Combination" Well, by C. K. Eilerts and M. A. Schellhardt.

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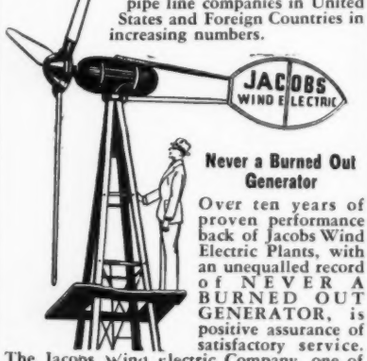

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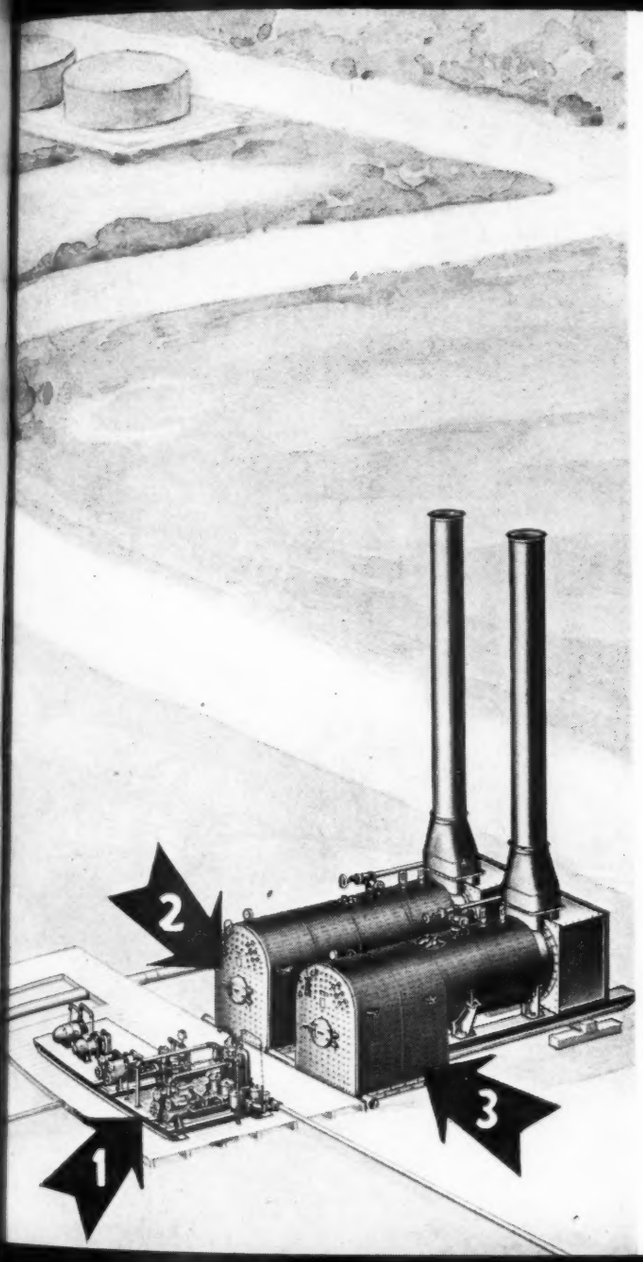

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Method for Calculating Oil Evaporation Losses

Part 2

By WALTER F. ROGERS

Houston Chemical Laboratory,
Gulf Oil Corporation, Gulf Production Division

Calculation of Annual Loss from Storage

It is now possible to substitute the constants obtained for an 80,000-bbl. storage tank painted with aluminum paint and filled to within one ft. of the tank top.

Gal. gasoline lost per year = $\left[\left(V \times \frac{460 + t_2}{460 + t_1}\right) - V + \frac{VdpC}{760}\right]$ gal. per M. $\times$ 365 C / 1000 becomes

$\left[\left(35{,}600 \times \frac{460 + 90.9}{460 + 60.8}\right) - V + \frac{35{,}600\ dpC}{760}\right]$ gal. per M. $\times$ .365 C or

(2000 + 46.8 dpC) gal. per M. $\times$ .365 C

Where dp = daily average vapor-pressure change in mm. of Hg of crude oil between 60.8 deg. fahr. and 90.9 deg. fahr.

gal. per M. = gallon of gasoline per 1000 cu. ft. of vapors breathed from the tank.

C = correction factor for depth of oil from tank roof.

It is only necessary to determine for any crude its vapor-pressure curve between the ranges 60.8 deg. fahr. and 90.9 deg. fahrenheit. The substitution of these data in the formula gives the loss in gasoline per year.

Typical Calculations

To show how this method may be used to calculate evaporation losses for typical conditions a few calculations will be made.

First, determine for the oil in Fig. 5 the length of time required to bring its vapor-pressure curve from condition A to condition B and from condition B to condition C. In this case the oil is taken as stored in an 80,000-bbl. tank, one ft. from the eaves, 7½-ft. cone, the tank painted aluminum.

A. *Condition A to B*

Gal. gasoline lost per year = (2000 + 46.8 dpC) gal. per M. $\times$ .365 C

dp for 60.8 to 90.9 deg. fahr. = 135 mm. Hg.

Gal. of gasoline lost will be 80,000 $\times$ .07 = 5600

Time is x instead of one year and .365 will be $\frac{x}{1000}$

C = height of 7.5 ft. + 1 ft. = 8.5 ft. = .82

Gal. per M. will not be $\frac{585}{760}$ as most of this vapor pressure is methane and ethane. The vapor pressure of the gasoline hydrocarbons will, however, not be less than shown by curve B at 75.8 deg. fahr. = 310 mm. Hg.

The gal. per M. = $\frac{310 \times 1000}{760 \times 27.6} = 14.7$

Then $5600 = (2000 + 46.8 \times 135 \times .82) \frac{14.7 \times .82 \times X}{1000}$

$X = \frac{5600}{86.9} = 64.5$ days

B. *Condition B to C*

Gal. gasoline lost will be 80,000 $\times$ .08 = 6400

dp for 60.8 deg. fahr. to 90.9 deg fahr. = 125 mm.

C for height 8½ ft. = .82

Time in days = X

Gal. per M. = $\frac{275 \times 1000}{760 \times 27.6} = 13.1$

$6400 = (2000 + 46.8 \times 125 \times .82) \frac{13.1 \times X \times .82}{1000}$

$77.0\ X = 6400$

X = 83 days

Thus to lose 0.15 percent of this crude by evaporation will require 64.5 + 83 = 147.5 days

Second, determine the annual evaporation losses of the crude oils shown in Fig. 6, under the condition of storage as described above:

Gal. gasoline lost per year = (2000 + 46.8 dpC) gal. per M. $\times$ .365 C

C = .82

From the calculated data shown in the table below we see that the losses from the Seminole, East Texas, and Ranger crudes are high and warrant some consideration in regard to reducing the loss. The losses from the other crudes are comparatively low and stor-

Oil	dp (mm. Hg)	Avg. Pressure at 75.8 deg. fahr. (mm. Hg)	Gal. per M
Seminole	95	225	10.8
East Texas	80	210	10.0
Ranger	65	220	10.5
Panhandle Mixture	50	120	5.7
Burkburnett	50	90	1.9
West Texas Mixture	35	70	1.5

Substituting these data in the formula we find:

Oil	Gal. Gasoline Lost per Year	Bbl. Gasoline Lost per Year	Percent of 80,000 Bbl.
Seminole	17,900	426	0.53
East Texas	14,900	350	0.43
Ranger	13,900	326	0.41
Panhandle Mixture	6,800	160	0.20
Burkburnett	2,210	52	0.065
West Texas Mixture	1,490	35	0.043

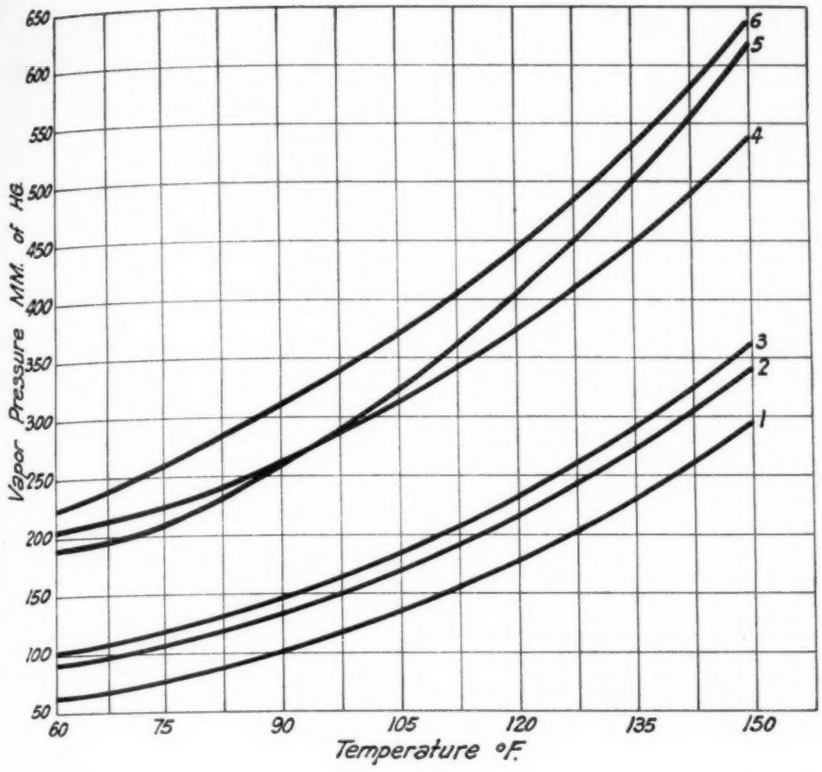


Fig. 6. Vapor pressure of crude oil

Curve	Vapor pressure at 60.8 deg. fahr.	75 deg. fahr.	90.9 deg. fahr.	Oil
6	220	255	315	Seminole
5	190	210	270	East Texas
4	205	220	270	Ranger
3	100	120	150	Panhandle Mixture
2	90	105	140	Burkburnett
1	70	80	105	West Texas Mixture

age in the type tank for which the calculation was made is satisfactory.

Third, determine the average loss in shipping 80,000 bbl. of East Texas oil through three pipe-line stations. At each station the oil is pumped at the rate of 20,000 bbl. per day and the oil is left in storage 30 days. $C_1 = .82$ for oil in storage.

The time for emptying and filling the three different tanks is $8 \times 3 = 24$ days. During this time the average oil height in the tank is 20 feet. $C_1 = .52$.

Emptying and filling loss =

$$(2000 + 46.8 \times 80 \times .52) \times \frac{10.0 \times 24 \times .52}{1000} = 493 \text{ gal.}$$

Storage losses =

$$(2000 + 46.8 \times 80 \times .82) \times \frac{10.0 \times 90 \times .82}{1000} = 3760 \text{ gal.}$$

Total = 4253 gal. or 101 barrels.

Correlation of Calculated With Actual Losses

John H. Wiggins Company[2] and the Chicago Bridge and Iron Company[3] have published accurate data as to the breathing losses and the gasoline losses from tanks containing gasoline. Wiggins[2] measured the breathing losses from a 55,000-bbl. tank containing 1 ft. 2 in. of gasoline. They found for October 10th 29,000 cu. ft. of gas was vented from the tank.

It is possible to calculate the breathing loss assuming the temperature for this day in October to be the same as the average October temperature.

$$\Delta V \text{ (cu. ft.)} = \left(V \times \frac{460 + t_2}{460 + t_1} \right) - V + \frac{VdpC}{760}$$

$V = 307{,}000$ cu. ft.
$t_2 = 92$ deg. fahr.
$t_1 = 62.6$ deg. fahr.
$dp = 420 - 260 = 160$ (from gasoline vapor-pressure chart in report)
C, height to oil of 37 ft. = .39

$$\Delta V \text{ (cu. ft.)} = \frac{(307{,}000 \times 552)}{522.6} - 307{,}000 + \frac{307{,}000 \times 160 \times .39}{760}$$

$$= 14{,}000 + 25{,}200 = 39{,}200 \text{ cu. ft.}$$

The difference in the calculated and actual breathing of the tank was 39,200 — 29,000 = 10,200 cu. ft. or

$$\frac{10{,}200}{29{,}000} =$$

35 percent in excess of the actual. In this case it is easy to understand how a considerable difference could exist between the actual and calculated values primarily due to the inability to transfer the maximum vapor temperature to the gasoline surface. Also, the temperature cycle for the day in question had to be assumed.

As a second test of evaporation loss the Chicago Bridge and Iron Company[3] report as Test 6 the loss of gasoline from a tank 35 ft. high and having a diameter of 100 feet. The gasoline was stored within 10 ft. of the top of the tank shell. The gasoline was stored for 22 days in July. The gauged loss was 6450 gallons. The average temperature for June, July, and August for Texas is 110.5 deg. fahr. maximum and 76.3 deg. fahr. minimum.

The calculated loss in

$$\text{Gal. gasoline} = \left[\left(V \times \frac{550.9}{520.8} \right) - V + \frac{VdpC}{760} \right] \frac{\text{gal. per M.} \times 22\,C}{1000}$$

V, (Volume) = 94,775 cu. ft.
dp from vapor-pressure chart in report between 110.5 deg. fahr. and 76.3 deg. fahr. = 245 mm. Hg.
C for 16 ft. 2 in. = .66

$$\text{Gal. per M.} = \frac{\text{avg. v.p. from curve} \times 1000}{760 \times 27.6} = \frac{442 \times 1000}{760 \times 27.6} = 21.0$$

Substituting in the formula,

$$\text{Gal. gasoline} = \left[\left(\frac{94{,}775 \times 570.5}{536.3} \right) - 94{,}775 + \frac{94{,}775 \times 245 \times .66}{760} \right] \frac{21 \times 22 \times .66}{1000}$$

$= (6170 + 20{,}150)\ .305 = 8020$ gal.
Actual loss = 6450 gal.

$$\text{Percent of actual loss} = \frac{8020}{6450} = 124 \text{ or}$$

24 percent in excess of the actual loss.

As a third test it is possible to compare the calculated and actual loss obtained for the oil in Table 1, Tank B. The gauged loss for 271 days was 437 bbl. and for 289 days was 314 bbl., somewhat erratic figures. This crude had a vapor-pressure curve almost identical with that of the Seminole crude shown in Fig. 5, Curve 6. The calculated loss per year was 426 barrels. In this case the 426 bbl. calculated loss is probably more nearly accurate

(Continued on Page 52)

[2]J. H. Wiggins, Report on Steel Balloon and Vapor Savings System, 1930.

[3]Chicago Bridge and Iron Company, Determination of Evaporation Losses.

— Of Interest to th

The United States Circuit Court of Appeals, tenth circuit, in the case of the *Chicago Pneumatic Tool Company versus Hughes Tool Company* affirmed the decree of the District Court of the United States for the western district of Oklahoma, holding the rock bit cutters made by the Chicago Pneumatic Tool Company constitute infringement of Patent No. 1,647,753 relating to the form of the cutters or teeth on the cones.

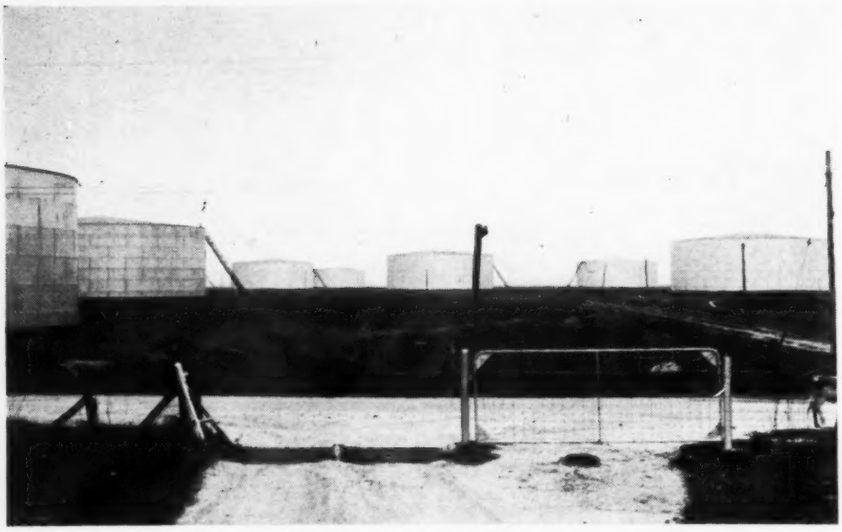
The Court said, "And a device infringes if it embodies the essential principles taught by the patent . . . The departure from the disclosure of the patent is merely colorable. An insubstantial departure from a patent without change in principle does not avoid infringement."

Drilling Industry

The United States Circuit Court of Appeals, tenth circuit, in *Southwestern Tool Company versus Hughes Tool Company*, affirmed the decree of the District Court of the United States for the western district of Oklahoma against the Southwestern Tool Company.

The United States Circuit Court of Appeals held that where parts repaired or replaced are separately covered by a patent, as is the case with the teeth on the cutters of Hughes cones, and Defendant welded new teeth to the cutters, the practice "is well outside the domain of permissible repair and restoration and plainly constitutes infringement."

Throughout more than the past quarter century—HUGHES ROCK BITS have been more than "Just Bits"—They have successfully carried the responsibility of Hole Making—throughout the Rotary Fields of the world



Pipe line tank farm

(Continued from Page 49)

than the erratic but approximately similar gauged losses.

Discussion and Conclusions

It is believed that the method presented here has a sphere of usefulness in determining evaporation losses. It cannot be used for short-time tests unless the temperatures are measured, as for a short period the temperatures may be radically different from those given here as monthly averages. For oil in storage for a year the temperatures given here probably hold very well for the United States.

There are, of course, many approximations used for the calculations. For instance, if C_1 were taken as .94 or .96 the equilibrium correction for great distances below the tank cone deviates greatly from the correction where $C_1 = .95$. Again, the concentration of gasoline in the vapors is taken directly from the vapor-pressure curve. This is in error by that fraction of the vapor resulting from residual amounts of non-condensing gases in the crude. Again, the oil temperature does not follow exactly the vapor temperature. As pointed out, however, this error is compensated to some extent by the higher minimum temperature of the oil as compared with the vapor temperature. In any case the calculated losses have been found to be on the high side so unless the oil has an unusually high calculated loss a field test or steps to reduce the loss will probably not be warranted.

One of the most important results of this work lies in showing the importance of the vapor space in promoting evaporation losses. Little can be done about changing the tank temperature cycle or the oil vapor pressure. This leaves the tank vapor space as the main controllable variable. The evaporation loss is directly proportional to the vapor space and there is no reason for building large vapor space in a tank. Oil storage tanks should be built with roof as flat as possible to eliminate the unnecesasry vapor space and reduce evaporation losses.

ACKNOWLEDGMENT

The writer wishes to thank the Executive Department of the Gulf Oil Corporation, Gulf Production Division, for their kind permission to publish this article.

Pulsation Dampener in Gas Suction Line

THE surging that occurs when compressors are operated "in step" hinders the accurate metering of gas. When Otho Grimes planned construction of a gasoline plant in the Porter field, near Mt. Pleasant, Michigan, he knew from experience that the use of pulsation drums would facilitate measurement of the gas produced by the wells, so he installed a three-ring, welded vessel in a horizontal position adjacent to the compressor building. Gas enters the drum at the center of the more remote head, and the outlet is situated in the upper surface at the end nearer the compressors.

Gas from nearby wells passes through a horizontal scrubber, an orifice meter, and the pulsation drum to the compressors. The effectiveness of this arrangement is illustrated by the smoothness of the chart records obtained as contrasted with the "sunburst" type of records commonly obtained when compressor shock is transmitted directly to the gas in the orifice fitting.

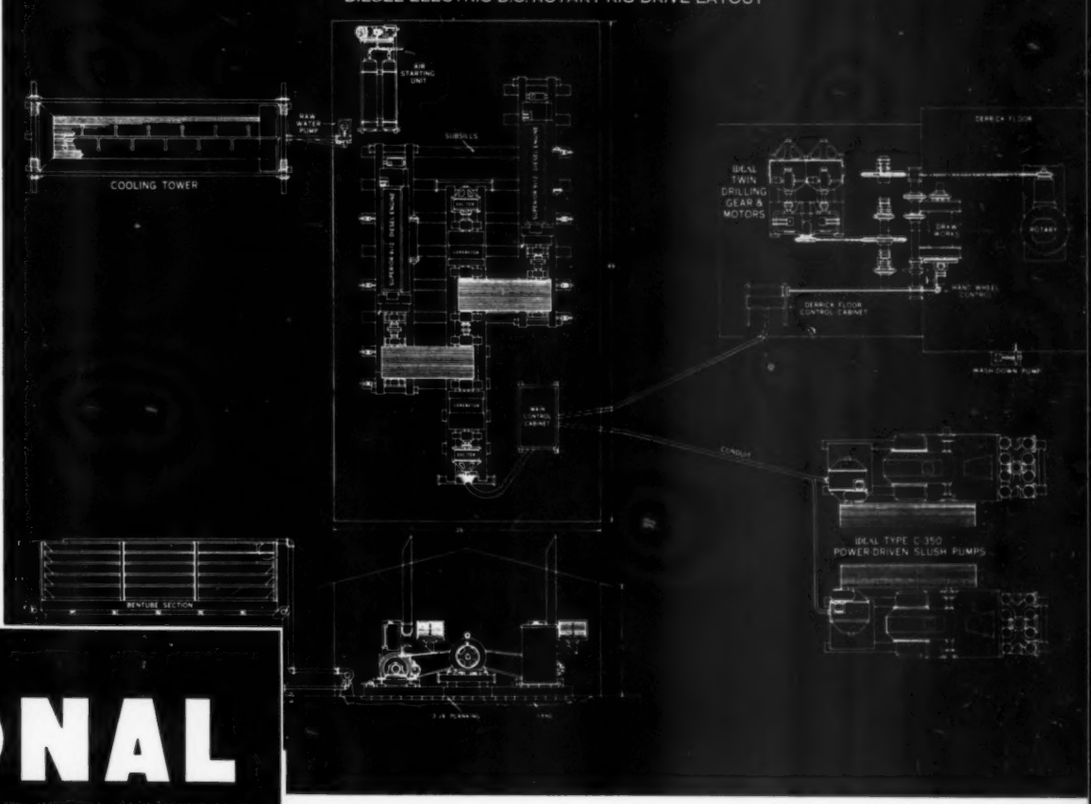
Pulsation dampeners in gas suction line between field scrubber and compressors in Grimes Gasoline Company's plant in the Porter field southeast of Mount Pleasant, Michigan

NATIONAL
DIESEL ELECTRIC ROTARY RIGS
MAKING DEEP WELL HISTORY

● National Diesel Electric Rigs are demonstrating their speed, dependability and economy in all principal deep drilling areas. Power equipment is available in various sizes for different depth requirements. Typical ratings are as follows:

	HEAVY DUTY RIG	MEDIUM DUTY RIG
PRIME MOVERS	2—350 HP, 600 RPM 8-cylinder Superior Vertical Diesel Engines	2—260 HP, 600 RPM 6-cylinder Superior Vertical Diesel Engines
MAIN GENERATORS		
	1—200 KW, 200 Volt, 1200 RPM	1—125 KW, 200 Volt, 1200 RPM
	1—250 KW, 200 Volt, 1200 RPM	1—175 KW, 200 Volt, 1200 RPM
DRILLING MOTORS		
	2—200 HP, 200 Volt, 900 RPM Twin, or alternatively	2—150 HP, 200 Volt, 900 RPM Twin or alternatively
	1—200/400 HP, 200/400 Volt, 450/900 RPM Single	1—150/300 HP, 200/400 Volt, 450/900 RPM Single
SLUSH PUMP MOTORS		
	1 or 2—300 HP, 200 Volt, 900 RPM	1 or 2—200 HP, 200 Volt, 900 RPM

DIESEL ELECTRIC D.C. ROTARY RIG DRIVE LAYOUT

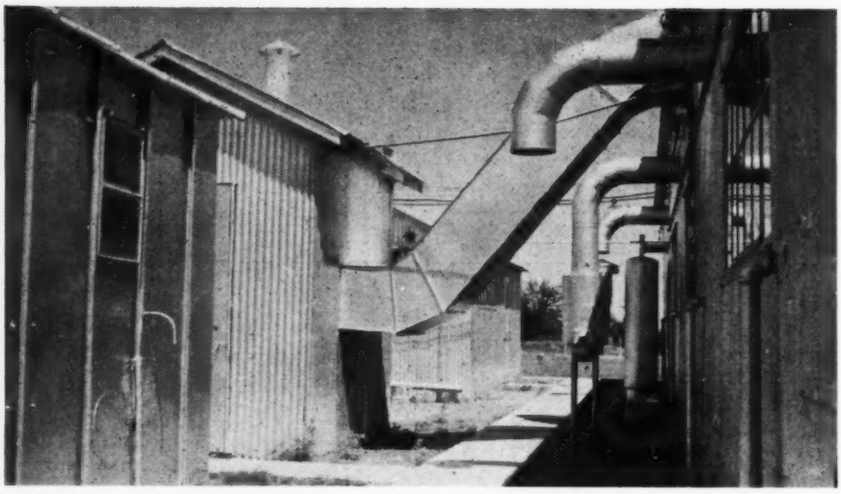


NATIONAL

THE NATIONAL SUPPLY COMPANY

EXECUTIVE OFFICES: PITTSBURGH, PA.
DIVISION OFFICES: FT. WORTH, TEXAS; TULSA, OKLA.; TORRANCE, CALIF.
GENERAL SALES OFFICE: TOLEDO, OHIO

● A new depth record was set for Oklahoma when Gulf Oil Company No. 1 Thomas in southeastern Grady County was recently carried to a depth of 11,415 feet. This well was drilled by the Parker Drilling Company with a National Heavy Duty Diesel Electric Direct Current Rotary Rig Drive.

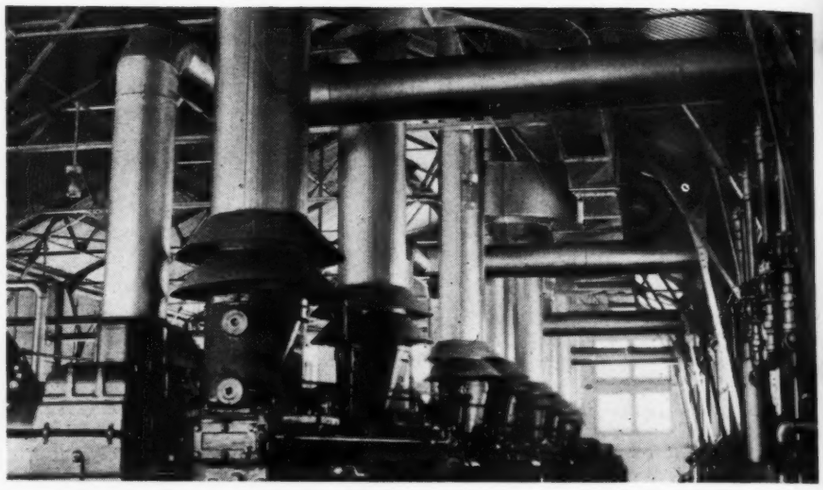


Ducts leading from circulating fan to engine room of Oklahoma Natural Gas Company's Quinton, Oklahoma, compressor station

By
J. C. ALBRIGHT

Compressor Station Heating System Utilizes Waste Heat

Hot air from engine exhausts is carried to various parts of the compressor room by a special circulator unit and system of ducts — Industrial-type heating unit is provided for use only when engines are not in operation



Deflector flanges are used on all exhaust piping. Also to be seen are the distribution ducts that carry air from the circulator fan

AFTER the gas field near Quinton, Oklahoma, was fully developed, reservoir pressure declined to a point that made compressor stations necessary to transport gas to cities on the Oklahoma Natural Gas Company's distribution system. The flowing pressure, 190 lb. gauge, was sufficient to place gas in the mains for short deliveries, but to move the gas greater distances compressors were required. Consequently, a four-unit plant was constructed near the Pittsburg-Haskell county line, approximately 45 miles south of Muskogee, which was designed for semi-automatic operation.

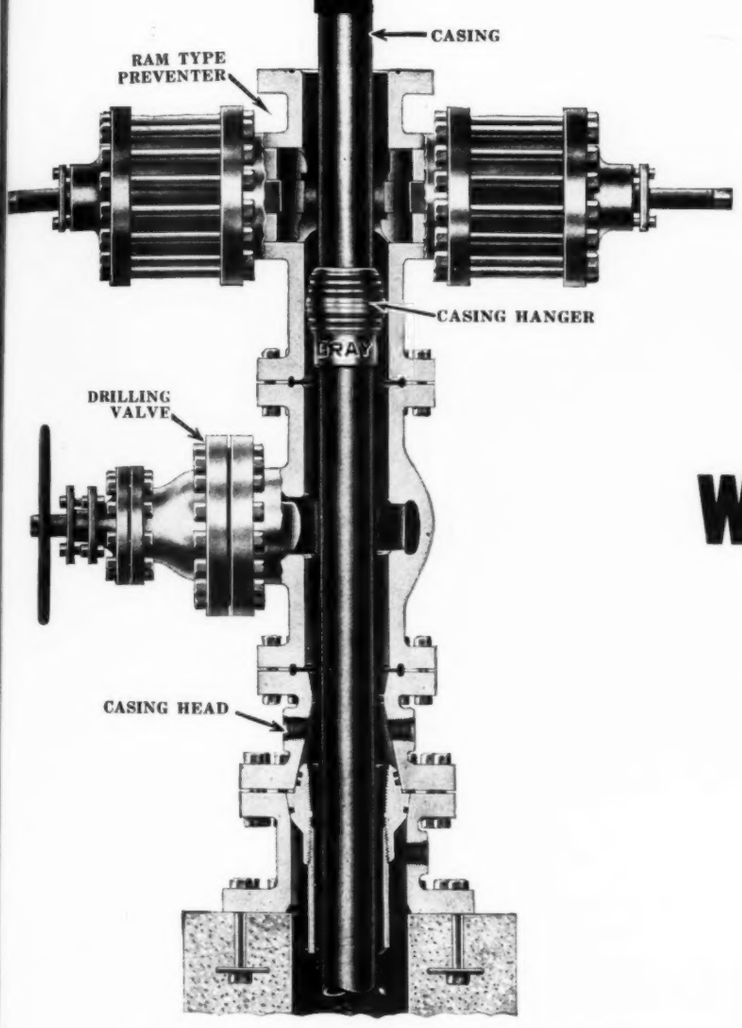
This station contains at the present time four horizontal gas engines, equipped with 7½-in. compressor cylinders, having inverted power cylinders, vertical exhaust piping extending through the building roof, and outside mufflers. Jacket water is cooled in a conventional-type louver tower, elevated well above the ground level so water may flow from the louver basin into a conventional wooden tank that supplies water for circulation. After being used the water flows from the jackets to a hot well at ground level. The hot well is equipped with an electrically-operated float that controls the centrifugal circulating pump, which lifts the water back over the louver tower for cooling.

As minimum attention is desirable in operation of this station, several features not generally found in similar plants have been incorporated. Among these is an engine-room heating system, designed primarily to utilize waste heat from the engine exhaust to maintain the interior temperature required to prevent the oil chilling. The equipment was installed complete for approximately $1050.

The compressor building is 32 ft. wide, 80 ft. long, and 12 ft. from concrete floor to roof truss. Ventilators of the usual type are situated on the ridge of the building to ventilate the room during summer months. They are fitted with shutters to prevent escape of heated air during winter. Sheet-steel jackets 15 in. in diameter enclose the exhaust pipes, extend through the building roof, and have weather shields attached to the upper ends. These may be opened to allow escape of hot air traveling along the exhaust pipes, or may be closed to control circulation during periods when it is necessary to maintain within the building a temperature above atmospheric.

The hot-air system consists of a circulator unit, an auxiliary building housing the unit, and a system of ducts to carry air where needed. The circulating equipment includes an industrial heating unit, which has a capacity of 400,000. B.t.u. input and a blower

BUILT INTO the GROUND



Landing casing through control equipment—one stage in Gray Planned Procedure

GRAY... SYSTEMS OF WELL CONTROL

Include

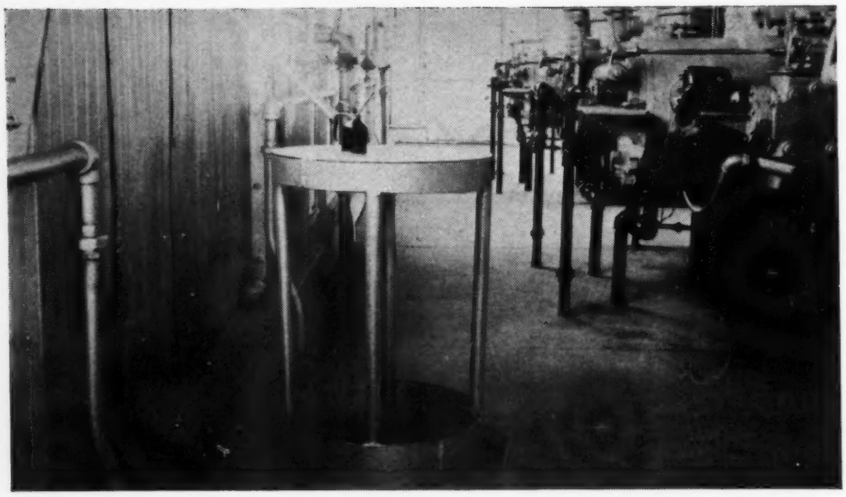
a complete sequence of operations in which each stage is seen and provided for

Before

Operations Begin

This planned procedure assures complete mechanical control during and between all operations as the well is BUILT INTO THE GROUND.

GRAY
TOOL COMPANY
HOUSTON – TEXAS



Cold air intake opening in engine room floor. Air enters here and flows through underground piping to the circulator fans.

capacity of 5200 cu. ft. of air per minute. The unit is operated by a 1-hp. motor using power generated at the station by a gas-engine-driven generator.

The system for directing the flow of air in the building includes an underground duct, 24 in. in diameter, leading from the compressor room to the circulator. The circular opening in the floor of the building is covered by a flat lid attached to four 2-in. risers about 36 in. above the level of the concrete, and is provided with a shield to prevent sweepings and small tools from falling into the air system.

Air is removed from the building through this duct by the blower and returns to the building through a duct 20 in. wide and 40 in. deep. This duct enters the engine room just below the eaves at the center of the side of the building, branching inside to form two sections, each section being connected to two compressor units. This duct is 8 in. wide and 20 in. deep, suspended from roof girders and attached to each individual exhaust pipe jacket.

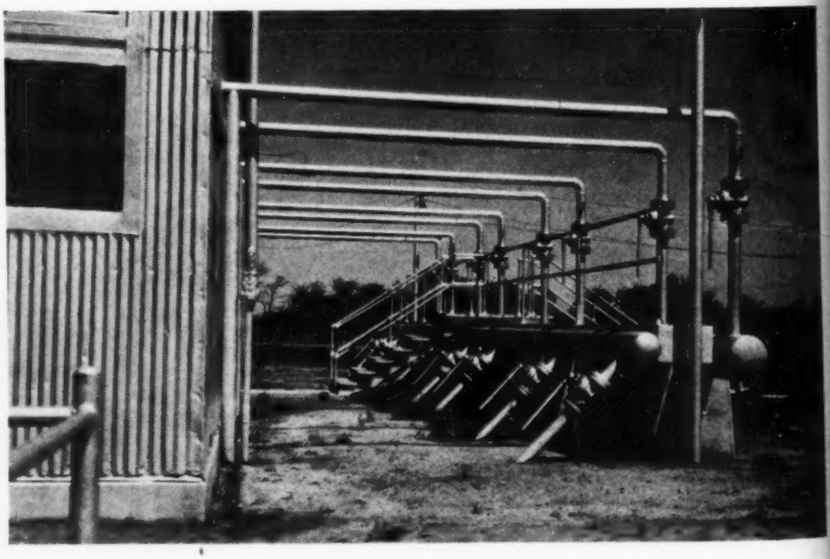
These sheet-steel jackets rest upon the cast exhaust of the power cylinders and have deflector sheets attached near the lower end. Immediately above these rings the jackets are perforated with several rectangular slots and a second deflector ring, or sheet, is attached just above the openings. The slots permit hot air to flow from the jackets, and the deflectors distribute it over the engine and throughout the engine room. The upper end of the jackets, normally open to the atmosphere during warm weather, can be closed by lowering the weather shields to prevent escape of hot air that is then directed downward through the slots in the lower end of the jackets.

The duct connecting the blower with the exhaust pipe jackets has controlled openings to avoid excessive heating of the building, and by adjusting the openings the air may be recycled without passing through the exhaust jackets. The covers are pivoted in the lower side of the duct, and are equipped with a counterweight on one end and a chain on the other. A slotted latch is attached to the lower side of the duct near the opening, through which the chain may be passed, locking the cover in place at the point desired. When outside temperature drops to 0 deg. fahr., inside temperature may be maintained as high as 50 deg. fahr. without difficulty. Waste heat is utilized only when the engines are operated, but when the station is shut down for any reason in winter, the heater included with the industrial unit may be operated and the temperature of the building maintained.

The cost of the unit is as follows:

Duct system	$ 400.00
Blower and motor	486.00
Blower building	160.00
	$1,046.00

In older stations it is necessary to operate steam boilers to provide sufficient warmth in the buildings to prevent congealing of oil and possible freezing of jacket water in idle engines, and this requires the attention of more than one man for operation. This station has been operated by only one employee during severe weather, additional help being required only to start the engines. Lease men are called in to assist in "spotting" the engines and after the required number of engines are running the operator attends to all operating details.



Headers are above ground to prevent soil corrosion and facilitate maintenance of equipment

MANY OF THE MOST COMMONLY EXPERIENCED DRILLING DIFFICULTIES ARE DUE TO THE USE OF IMPROPER DRILLING MUD

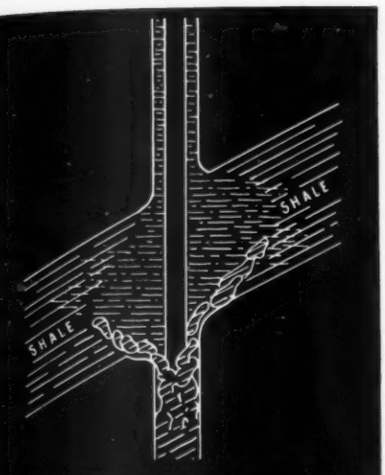
Caving hole, stuck drill pipe, blowouts—these and other difficulties encountered in drilling through heaving or caving shale often can be eliminated by the use of BAROID Products.

AQUAGEL—either used alone with water or as an admixture—builds a thin cake on the walls of the hole and reduces the loss of water to the formation, thus eliminating some of the causes of trouble with heaving shale.

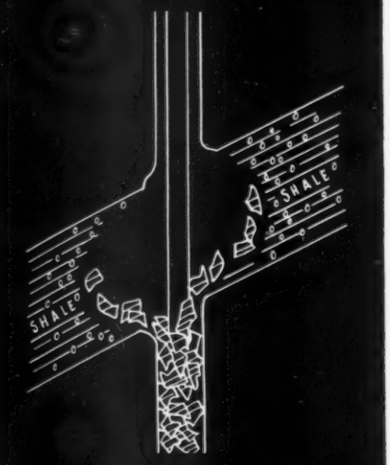
Where weighted muds are required to hold the formation in place or to confine oil, gas, or water to their respective formations, a combination of BAROID and AQUAGEL yields a mud of low viscosity and high unit weight; a mud which is non-corrosive and which will release gas readily.

Since shales frequently raise the viscosity of drilling mud to the point where it easily becomes gas-cut, STABILITE can be added before the danger point is reached to maintain a thin mud and release entrained gas.

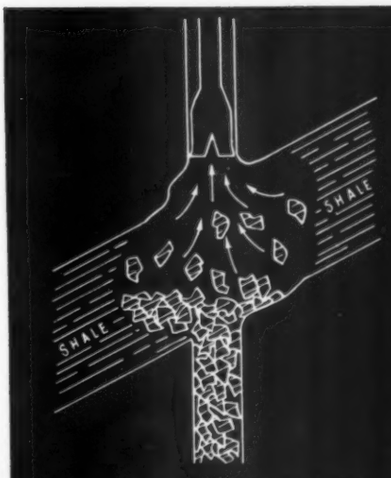
To help prevent drilling difficulties, always use BAROID Products. They have been successful in thousands of wells.



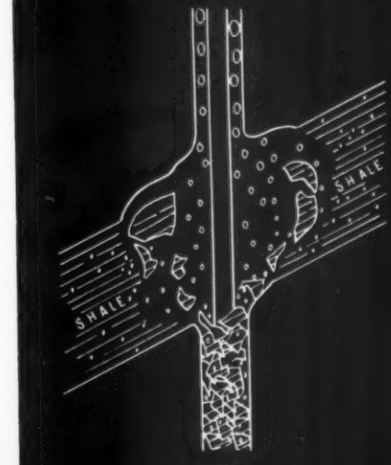
Hydrous Disintegration of Shale. Water from drilling mud causes swelling and disintegration of the shale, forcing it to heave into the open hole. A drilling mud with good wall-building qualities, i.e., low water loss, will help check this cause of heaving shale.



Gas Pockets Which Cause Shale to Heave. Shale impregnated with gas will slough into the open hole unless the drilling fluid has sufficient weight to control the gas pressure.



Swabbing Effect of Drill Pipe. Too rapid withdrawal of drill pipe creates a pressure differential which causes shale to heave into hole. The use of a drilling mud which forms only a thin, but impervious, cake will aid in reducing the swabbing effect.



Gas-Cutting Effect. Mud which contains entrained gas has lost much of the weight necessary to prevent shale from caving. The use of a thin mud which does not readily gas-cut is essential in drilling heaving shales in pressure zones.

BAROID PRODUCTS

BAROID—Extra-Heavy Drilling Mud. • AQUAGEL—Trouble-Proof Colloidal Drilling Mud. • STABILITE—An Improved Chemical Mud Thinner. • BAROCO—An Economical, Salt Water-Resisting Drilling Clay. • FIBROTEX—For Preventing or Regaining Lost Circulation in Drilling Wells.

Stocks carried and service engineers available in all active oil fields. Look for this trade mark under "Oil Well Drilling Mud" in your classified telephone directory for our nearest service engineer and distributor.

BAROID SALES DEPARTMENT

NATIONAL PIGMENTS & CHEMICAL DIVISION OF
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BAROID SALES OFFICES • LOS ANGELES • TULSA • HOUSTON

Fuel Costs For Various Types of Power

Costs of gas, butane, gasoline, Diesel fuel, and electricity are compared on the basis of equal horsepower developed.

By J. ERICH BRUHN

IN selecting an engine for oil-well pumping or for rotary or cable-tool drilling it is desirable when fuel must be purchased or when natural gas containing sulphur must be treated to compare the cost of the various fuels prior to selecting the type of engine that would operate at the lowest fuel cost.

The attached table was made for this purpose and shows comparative fuel cost for various types of engines as well as comparative treating cost for removing sulphur content from natural gas. This table does not incorporate any other operating costs such as maintenance, lubrication, or fixed charges.

In making this table the following fuel consumption figures were used:

2-cycle gas engine	14 cu. ft. per b.hp-hr.
4-cycle gas engine	12 cu. ft. per b.hp-hr.
4-cycle gasoline engine	.70 lb. per b.hp-hr.
2-cycle Diesel engine	.52 lb. per b.hp-hr.
4-cycle Diesel engine	.45 lb. per b.hp-hr.
Electric motor	80 percent efficiency
Butane	32 cu. ft. per gal. and 3300 B.t.u. per cu. ft.
Caustic soda	2½ lb. required to remove 1 lb. free sulphur

These fuel consumption figures are based on full load conditions with some engine wear and were arrived at by averaging fuel consumption curves of several manufacturers of the same type engine. Relative fuel cost at part loads will be about the same as for full load as the fuel consumption per b.hp-hr. will increase in about the same proportion for each similar type engine.

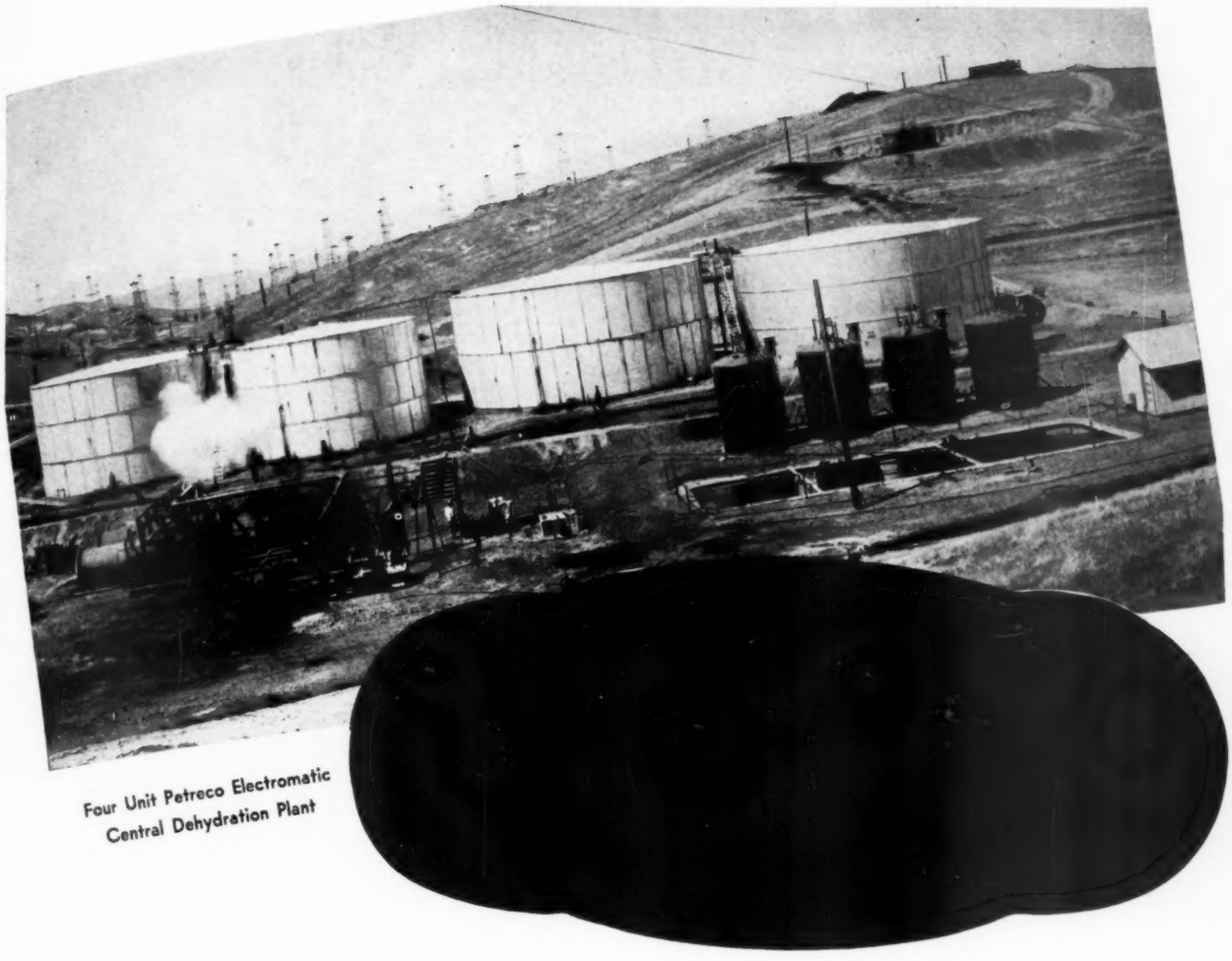
Where natural gas contains considerable hydrogen sulphide, it is often necessary to remove it by treating with caustic soda solution. Here considerable cost is involved if the sulphur content is relatively high, and by using the accompanying table it can be definitely determined whether it would be more economical to treat the gas that is available or to purchase some other kind of fuel.

To illustrate the manner in which the table can be used several practical applications are given:

It is necessary to install a pumping engine that must operate on natural gas containing 900 grains of free sulphur per 100 cu. feet. Caustic soda will cost six cents per lb. and the installation of a 2-cycle pumping engine is contemplated. Under the sulphur treating section of the table and under the 2-cycle side follow the column headed "6¢/lb." down to "900 grains." All figures on either side of this "900" are equivalent. In other words the cost of treating 900-grain gas with caustic soda at 6 cents per lb. is equivalent to 4.5-cent Diesel fuel for a 4-cycle Diesel engine, 4-cent Diesel fuel for a 2-cycle Diesel engine, 2.7-cent per gal. gasoline for a 4-cycle gasoline engine, 19.3-cent per 1000 cu. ft. purchased natural sweet gas for a 2-cycle and 22.5-cent for a 4-cycle gas engine. Equivalent butane cost would be 1.9 cents per gal. for a 2-cycle and 2.25 cents per gal. for a 4-cycle engine. Equivalent electric rate for operating an electric motor would be .29 cents per kw-hr. Use of any fuel costing less would therefore be cheaper than treating the 900-grain sulphur gas with caustic soda costing 6 cents per pound.

A drilling contractor on a wildcat operation and having a mechanical engine rig desires to use either butane or Diesel fuel. By making comparison on the table selection of the more economical fuel can be quickly made.

Diesel engine, Diesel fuel, cents per gal.		Gasoline engine, 4-cycle, gasoline, cents per gal.	Gas engine, natural gas, cents per 1000 cu. ft.		Gas engine, butane, cents per gal.		Electric motor, electricity, cents per kw-hr.	Number of grains of hydrogen sulphide per 100 cubic feet of natural gas that can be removed with caustic soda scrubber at caustic soda price per lb. as shown. (No charge for natural gas included)											
								2 cycle						4 cycle					
4 cycle	2 cycle		2 cycle	4 cycle	2 cycle	4 cycle		3c lb.	4c lb.	5c lb.	6c lb.	7c lb.	8c lb.	3c lb.	4c lb.	5c lb.	6c lb.	7c lb.	8c lb.
0.5	0.44	0.3	2.1	2.5	0.2	0.25	.03	200	150	120	100	86	75	233	175	140	117	100	88
1.0	0.88	0.6	4.3	5.0	0.4	0.50	.06	400	300	240	200	171	150	467	350	280	233	200	175
1.5	1.3	0.9	6.4	7.5	0.6	0.75	.10	600	450	360	300	257	225	700	525	420	350	300	263
2.0	1.8	1.2	8.6	10.0	0.9	1.00	.13	800	600	480	400	343	300	933	700	560	467	400	350
2.5	2.2	1.5	10.7	12.5	1.1	1.25	.16	1000	750	600	500	429	375	1167	875	700	584	500	438
3.0	2.6	1.8	12.9	15.0	1.3	1.50	.19	1200	900	720	600	514	450	1400	1050	840	700	600	525
3.5	3.1	2.1	15.0	17.5	1.5	1.75	.22	1400	1050	840	700	600	525	1633	1225	980	817	700	613
4.0	3.5	2.4	17.1	20.0	1.7	2.00	.26	1600	1200	960	800	686	600	1867	1400	1120	934	800	700
4.5	4.0	2.7	19.3	22.5	1.9	2.25	.29	1800	1350	1080	900	771	675	2100	1575	1260	1050	900	788
5.0	4.4	3.0	21.4	25.0	2.1	2.50	.32	2000	1500	1200	1000	857	750	2334	1750	1400	1167	1000	875
5.5	4.8	3.3	23.6	27.5	2.4	2.75	.35	2200	1650	1320	1100	943	825	2567	1925	1540	1284	1100	963
6.0	5.3	3.6	25.7	30.0	2.6	3.00	.38	2400	1800	1440	1200	1028	900	2800	2100	1680	1400	1200	1050
6.5	5.7	3.9	27.9	32.5	2.8	3.25	.42	2600	1950	1560	1300	1114	975	3034	2275	1820	1517	1300	1138
7.0	6.2	4.2	30.0	35.0	3.0	3.50	.45	2800	2100	1680	1400	1200	1050	3267	2450	1960	1634	1400	1225
7.5	6.6	4.5	32.1	37.5	3.2	3.75	.48	3000	2250	1800	1500	1286	1125	3500	2625	2100	1751	1500	1313
8.0	7.0	4.8	34.3	40.0	3.4	4.00	.51	3200	2400	1920	1600	1371	1200	3734	2800	2240	1867	1600	1400
8.5	7.5	5.1	36.4	42.5	3.7	4.25	.54	3400	2550	2040	1700	1457	1275	4000	2975	2380	1984	1700	1488
9.0	7.9	5.4	38.6	45.0	3.9	4.50	.58	3600	2700	2160	1800	1543	1350	4200	3150	2520	2101	1800	1575
9.5	8.4	5.7	40.7	47.5	4.1	4.75	.61	3800	2850	2280	1900	1628	1425	4434	3325	2660	2217	1900	1663
10.0	8.8	6.0	42.9	50.0	4.3	5.00	.64	4000	3000	2400	2000	1714	1500	4667	3500	2800	2334	2000	1750
10.5	9.2	6.3	45.0	52.5	4.5	5.25	.67	4200	3150	2520	2100	1800	1575	4900	3675	2940	2451	2100	1838
11.0	9.7	6.6	47.1	55.0	4.7	5.50	.70	4400	3300	2640	2200	1885	1650	5134	3850	3080	2567	2200	1925
11.5	10.1	6.9	49.3	57.5	4.9	5.75	.74	4600	3450	2760	2300	1971	1725	5367	4025	3220	2684	2300	2013
12.0	10.6	7.2	51.4	60.0	5.2	6.00	.77	4800	3600	2880	2400	2057	1800	5600	4200	3360	2801	2400	2100
12.5	11.0	7.5	53.6	62.5	5.4	6.25	.80	5000	3750	3000	2500	2143	1875	5834	4375	3500	2918	2500	2188
13.0	11.4	7.8	55.7	65.0	5.6	6.50	.83	5200	3900	3120	2600	2228	1950	6067	4550	3640	3034	2600	2275
13.5	11.9	8.1	57.9	67.5	5.8	6.75	.86	5400	4050	3240	2700	2314	2025	6300	4725	3780	3151	2700	2363
14.0	12.3	8.4	60.0	70.0	6.0	7.00	.90	5600	4200	3360	2800	2400	2100	6534	4900	3920	3268	2800	2450
14.5	12.8	8.7	62.1	72.5	6.2	7.25	.93	5800	4350	3480	2900	2485	2175	6767	5075	4060	3384	2900	2538
15.0	13.2	9.0	64.3	75.0	6.5	7.50	.96	6000	4500	3600	3000	2571	2250	7001	5250	4200	3501	3000	2625
15.5	13.6	9.3	66.4	77.5	6.7	7.75	.99	6200	4650	3720	3100	2657	2325	7234	5425	4340	3618	3100	2713
16.0	14.1	9.6	68.6	80.0	6.9	8.00	1.02	6400	4800	3840	3200	2742	2400	7467	5600	4480	3734	3200	2800



Four Unit Petreco Electromatic Central Dehydration Plant

The Petreco Electromatic Dehydration Process is better suited to handling large quantities of oil through a central plant than any other method of treating emulsified crude. By this method the production from numerous wells can be treated by a single plant with minimum costs for tankage, fuel, labor and other items.

When large volumes of emulsified oil are accumulated at a central gathering station and dehydrated for shipment to pipe lines, it is of special importance that the treating method uniformly delivers oil that meets pipe line specifications without requiring additional time for settling; and at temperatures that will be acceptable to pipe line operators. And the Petreco process excels in meeting these essential requirements.

A Petreco central dehydration plant can be operated continuously or intermittently. The system is completely enclosed and precludes the loss of valuable light volatiles. Operation can be entirely automatic, requiring minimum attention.

Petreco engineers are available at all times for determining the most efficient and economical system to meet specific field conditions. Preliminary investigations involve no obligation whatsoever.

PETROLEUM RECTIFYING COMPANY OF CALIFORNIA
General Offices: 530 West Sixth Street • Los Angeles, California
Branch Offices: Houston, Texas
Branches and Service Men in Principal Oil Fields

PETRECO
Electromatic DEHYDRATION

Running Tour
WITH MEN IN THE INDUSTRY

LESTER G. METCALF, for the last eight years manager of refineries for the Union Oil Company of California, has been appointed director of manufacturing to succeed R. E. Haylett, deceased. Metcalf has been associated with the refining department of the Union Oil Company since 1917. He was appointed superintendent of the Oleum refinery in 1920, was transferred to Los Angeles as assistant manager of refineries in 1926, and made manager of refineries in 1930.

LESTER G. METCALF

T. G. DELBRIDGE, manager, Research and Development Department, The Atlantic Refining Company, Philadelphia, Pennsylvania, has been nominated for president of the American Society for Testing Materials. **J. J. SHUMAN,** inspecting engineer, Jones & Laughlin Steel Corporation, Pittsburgh, Pennsylvania, has been nominated as a member of the executive committee of the same organization.

MICHAEL L. HAIDER, chief engineer, Carter Oil Company, resigned recently to join the engineering staff of the Standard Oil Company of New Jersey. His headquarters will be in New York City. He is succeeded as chief engineer for the Carter Oil Company by **IVAN S. SALNIKOV,** division superintendent in western Osage County, Oklahoma.

P. J. HATTERMAN VAN OUDENOL, independent operator, Calgary, Alberta, Canada, has returned to Canada following an eight months' stay in Europe.

L. S. McDOWELL, general superintendent of production, American Liberty Oil Company, has moved his headquarters from Kilgore, Texas, to the company's general offices in Dallas.

GILBERT M. DePUY, production superintendent for the Mexican Gulf Oil Company, Tampico, Mexico, spent his vacation in Dallas, Texas.

J. B. AUG. KESSLER, managing director of the Royal Dutch Shell Group, Amsterdam, Holland, is in the United States on business.

TED A. HALL, who has been chief engineer of the production division of the Tide Water Associated Oil Company, making his headquarters in Houston, Texas, has been appointed chief oil appraisal engineer of the First National Bank in Dallas, Dallas, Texas. Expansion of the appraisal division was made necessary by the extent of the bank's oil financing activities, **EUGENE McELVANEY,** vice-president in charge of oil loans, stated. The bank's oil loans at the present time total approximately $17,500,000.

TED A. HALL

ROBERT GEORGE, independent operator, Bradford, Pennsylvania, and Mrs. George, recently returned from a trip to Africa, England, and Scotland.

HOWARD V. SMITH, for the last 11 years assistant superintendent of the Eldorado, Kansas, refinery of the Skelly Oil Company, has been appointed chief chemical engineer of the Barber Asphalt Corporation, Philadelphia, Pennsylvania, in charge of the company's technical department. **J. STROTHER MILLER, JR.,** formerly director of the technical department of the Barber Asphalt Corporation, has been promoted to technical adviser for the company.

L. H. MACK, who has been with the General American Oil Company at Gladewater, Texas, has been made chief engineer of the Bell Oil and Gas Company and will make his headquarters at Overton, Texas.

A. G. GUYMARD has been transferred by the Stanolind Oil and Gas Company from Houston, Texas, to the Barbers Hill district where he is field engineer.

HARVEY HARDISON, chief engineer of The Standard Oil Company of Texas, is now making his headquarters in the Tower Petroleum Building, Dallas, Texas, moving from Midland, Texas.

F. E. HATFIELD, production superintendent, West Texas district, Gulf Oil Corporation, having his headquarters at Odessa, will leave this month for Venezuela where he will be in charge of development work for the Mene Grande Oil Company, a Gulf subsidiary. **T. A. PICKERING,** assistant superintendent, succeeds Hatfield in West Texas, and **W. C. TODT** assumes Pickering's former duties.

W. D. LATHAM has been appointed district superintendent in the new Navarro Crossing field, Texas, by the Humble Oil and Refining Company. He has been a tool pusher with the company.

LEE S. MILLER, Detroit, has been made chief engineer of natural gas by the Michigan Public Utilities Commission. He has been a consultant in gas and petroleum geology in Michigan for the last several years.

Schlumberger ANNOUNCES TERMINATION OF INFRINGEMENT SUIT AGAINST GEOANALYZER

In the suit for infringement of Schlumberger patent No. 1894328 involving the electrical logging of drill holes, brought by Schlumberger Well Surveying Corporation against Geoanalyzer Corporation in California, the following decree was entered by the United States District Court for the Southern District of California, Central Division, on June 9, 1938.

IN THE UNITED STATES DISTRICT COURT, SOUTHERN DISTRICT OF CALIFORNIA, CENTRAL DIVISION.

Schlumberger Well Surveying Corporation, Plaintiff, vs. Geoanalyzer Corporation, Defendant. In Equity No. 873-S

FINAL DECREE

THIS CAUSE came on to be heard at this term and the Court having been fully advised in the premises, and it appearing that Lane-Wells Company, a corporation, has conducted the defense of this suit on behalf of the Geoanalyzer Corporation, the Defendant herein, and is privy thereto, now thereupon consideration thereof it is—ORDERED, ADJUDGED AND DECREED AS FOLLOWS:

1. That the Plaintiff, Schlumberger Well Surveying Corporation, is the sole and exclusive owner of all the right, title and interest in and to United States Letters Patent No. 1894328.

2. Patent No. 1894328, having been duly issued by the United States Patent Office is presumptively valid as to the single claim contained therein.

3. The use of an automatic recording device in the place of manual determinations of electrical values in such a device disclosed in the patent in suit is the equivalent thereof.

4. That the Defendant, Geoanalyzer Corporation, has infringed upon said United States Letters Patent No. 1894328 by making and using Electrical Devices for the Determination of Specific Resistivity embodying and containing the invention of said Letters Patent as set forth in the claim thereof.

5. That an accounting and costs having been waived by Plaintiff, there shall be no accounting by the Defendant of profits or damages, nor shall costs be taxed against either party herein.

6. That an injunction shall issue out and under the seal of this Court restraining the Defendant, Geoanalyzer Corporation, its officers, directors, associates, clerks, servants, agents, workmen, employees and confederates and each of them from directly or indirectly manufacturing, using or selling or causing to be manufactured, used or sold, or threatening to manufacture, use, or sell Devices embodying, employing, containing or adapted to practice the invention and improvements or discoveries described and claimed in United States Letters Patent No. 1894328.

7. Lane-Wells Company is in privity with the defendant herein.

Ralph E. Jenny,
United States District Judge.

DATED: June 9th, 1938.
APPROVED AS TO FORM UNDER RULE 44:
Lyon & Lyon,
Leonard S. Lyon,
Attorneys for Defendant.
Decree entered and recorded June 9, 1938.
R. S. Zimmerman, Clerk,
By Theodore Hocke, Deputy Clerk.
(ENDORSED)
FILED JUNE 9, 1938 R. S. Zimmerman, Clerk.
By Theodore Hocke, Deputy Clerk.

In connection with the termination of the litigation between Schlumberger Well Surveying Corporation and Geoanalyzer Corporation (defended by Lane-Wells Co.) by entry of the above decree Geoanalyzer assigned all of its patents and applications relating to electrical logging to Schlumberger, Schlumberger granted to Lane-Wells a license under all of its patents relating to electrical logging, and Lane-Wells granted to Schlumberger a license under all of its patents relating to gun perforating.

SCHLUMBERGER TAKES PLEASURE IN ANNOUNCING TO THE OIL INDUSTRY THAT IT WILL SHORTLY OFFER A COMPLETE SERVICE IN GUN PERFORATING WHICH HAS BEEN PRACTICED SUCCESSFULLY FOR YEARS IN FOREIGN COUNTRIES.

SCHLUMBERGER
WELL SURVEYING CORPORATION
HOUSTON, TEXAS—U. S. A.
"Electrical Well Logging"

LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

And there's the one about the whistle at the railroad crossing. Stop if you've heard it.

* * *

Doctor: The best thing for you is to stop drinking, smoking, and staying up late.

Patient: Well, doctor, you know, I don't think I'm worthy of the best. What's next best?

* * *

"Rollo seems to be very happy in his new work. What does he do?"

"He is doing literary work. He takes young lady authors around to give them material for their confession stories."

* * *

It Pays to Advertise

Doing business without advertising is like winking at a girl in the dark. You know what you are doing but no one else does.—*Exchange.*

* * *

"Have you any references."

"Sure, here's the letter: 'To whom it may concern, Bill Williams worked for us one week, and we're satisfied'."

* * *

Said a teacher in an Oklahoma school, "I wonder if any of you children have Indian blood?"

"I have," said Johnny.

"That's very interesting," said the teacher. "What tribe?"

"Oh, it wasn't exactly a tribe," answered Johnny, "just a wandering Indian."

* * *

"Was Ed shocked over the death of his wealthy aunt?"

"Shocked? He was electrocuted."

* * *

"My wife can be an angel when she wants to be."

"Mine, too—any time, now."

* * *

An egotist is a man who thinks as much of himself as you think of yourself.

* * *

"There's something odd about you this morning," said the dictator to his chief lieutenant. "Yes—I know what it is. For the first time since I've known you you've left off your medals."

The lieutenant looked down at his chest.

"Great scott," he cried, "I forgot to take them off my pyjamas."

And What About Inflation?

Prof.: What are the properties of heat and cold?

Stude.: Heat expands and cold contracts.

Prof.: Correct. Give an example.

Stude.: "In summer, when it's hot the days are long, and in winter when it's cold the days are short!

* * *

The general sent for his engineer—an old-fashioned, capable road builder.

"Jim," he asked, "how long will it take to throw a bridge across this river?"

"Three days," the engineer said, after running his fingers through his hair.

"Good," said the general: "Have the draftsman make the drawings right away."

Three days later the general sent for the engineer, hardly hoping the bridge could be done so soon.

"How's the bridge?" he asked.

"Bridge is made," was the reply, "and you can march across if you don't have to wait for them pictures. They ain't done yet."

* * *

She: Have you put the cat out, darling?

Darling (sleepily): No, I didn't even know it was on fire.

* * *

The old gray mare had her faults. That's why they put dashboards on buggies.

* * *

A woman and a daily newspaper are much alike:

They both have forms.

They always have the last word.

Back numbers are not in demand.

They have a great deal of influence.

They are well worth looking over.

They carry the news wherever they go.

They are much thinner than they used to be.

* * *

Then there was the man who sent his car to the auto laundry, and it came home with the horn button missing.

* * *

Burglar: Don't be scairt, lady, all I want is your money.

Old Maid: Oh, go away! You're just like all other men.

Eight-year-old Sadie was frequently sent home from school for forgetting to bring written excuses for tardiness or absence from classes. One day she was sent home to bring an important document, the birth certificate of her little brother, Joey, who was just starting to school. Her mother cautioned her to take great care of the document.

Sadie turned up at school crying.

"What's the matter, now?" asked the teacher.

"I've lost Joey's excuse for being born," she wailed.

* * *

Not Ripe

"These eggs are very small," complained the young housewife to her grocer.

"Straight from the farm this morning, madam," declared the grocer.

"That's the trouble with these farmers," she persisted. "They're so anxious to get their eggs sold they take them off the nest too soon."

* * *

A girl doesn't have to watch the speedometer to know what her boy friend is driving at.

* * *

He pulled into the garage with a horrible grinding of brakes and descending from his ramshackle two-seater asked to be shown some second-hand cars.

"Got tired of the old bus, I suppose?" the salesman inquired.

"No, not quite," replied the motorist, "but every time I park this thing, along dashes a policeman to make sure I've reported the accident."

* * *

Farmer: Yes, sir, that hired hand of mine is one of the greatest inventors of the century.

City Boarder: You don't say! What did he invent?

Farmer: Petrified motion.

* * *

Street Car Conductor: How old are you my little girl?

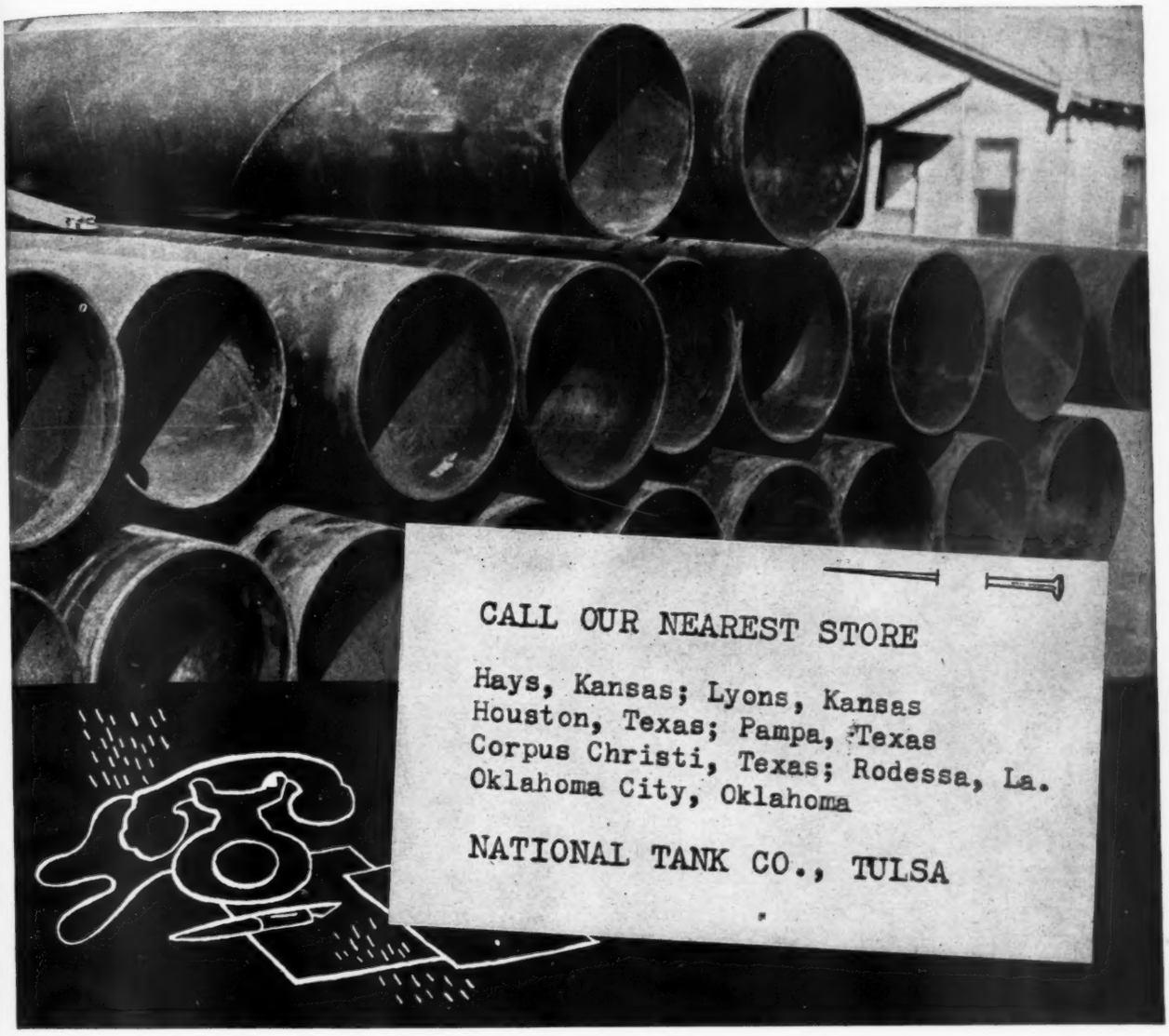
Little Boston Girl: If the corporation doesn't object, I'd prefer to pay full fare and to keep my own statistics.

* * *

"What is home without a mother?" said the good-looking young man.

"Well," replied the sweet young thing, "I am tonight."

SAVE UP TO 37%
WITH ARMCO SURFACE CASING


CALL OUR NEAREST STORE
Hays, Kansas; Lyons, Kansas
Houston, Texas; Pampa, Texas
Corpus Christi, Texas; Rodessa, La.
Oklahoma City, Oklahoma
NATIONAL TANK CO., TULSA

● Here at last is an improved lightweight casing that enables you to save up to 37 per cent on the cost of *surface* pipe that is cemented-in and never reclaimed.

Scientifically designed for the requirements of different string lengths, Armco Spiral Welded surface casing is easy to handle and set. No special expensive ends are needed for tongs, slips or elevators. And since the ends of the pipe are cut perfectly square, aligning in the hole is greatly simplified.

You can obtain Armco surface casing with economical slip joint couplings for field welding or with A.P.I. threaded ends and collars. Just write, telephone, or wire your needs to the nearest store of our distributor. Or address: The American Rolling Mill Co., Pipe Sales Div., 703 Curtis St., Middletown, Ohio; 538 Mayo Bldg., Tulsa, Okla.

ARMCO

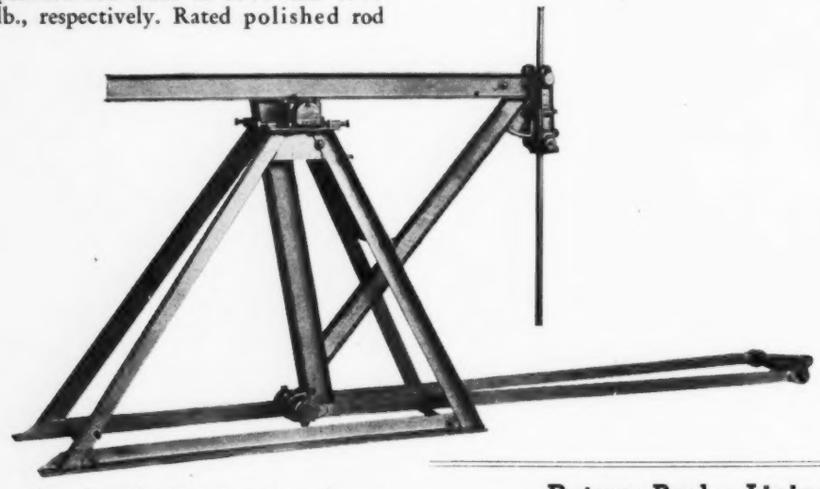
SURFACE CASING

DISTRIBUTED BY NATIONAL TANK CO., TULSA, OKLAHOMA, AND BRANCHES

MACHINERY and EQUIPMENT

National Pumping Jacks

TO fill the requirement of operators in shallow fields for lower maintenance cost and higher mechanical efficiency in pumping jacks, The National Supply Company, Toledo, Ohio, has made two recent additions to its Type D line. These are known as Types D-25 and D-45 and have rated polished rod loads of 2500 and 4500 lb., respectively. Rated polished rod stroke of both sizes is 30 in.; longer strokes may be taken, however, due attention being given to expansion and contraction in rod lines. For a given pull rod stroke, the polished rod stroke can be adjusted over a considerable range by moving the pull rod bearing box on the vertical member of the beam.



Types D-25 and D-45 jacks are, like the larger National Type D jacks for deep-well pumping, of the underpull pattern that reduces the number of pivot points to a minimum and provides for the greatest efficiency in counterbalancing. The frame is fabricated in halves for ease in handling, and the beam is assembled in one solid unit, provision being made for bolting on the various bearing parts. The entire jack is fabricated from structural steel by electric arc-welding.

Pull bar and saddle bearings are of the oil-bath, dust-proof type, equipped with oil seals. The hanger bearing has enclosed oil pockets at all bearing points. The jack beam is carried adjustably mounted on two bearing boxes on the frame, which permit longitudinal and angular movement, enabling the operator to align the hanger accurately over the center of the well and compensate for slight errors in erection. Complete additional specifications are given in the National Supply Company's descriptive bulletin No. 203.

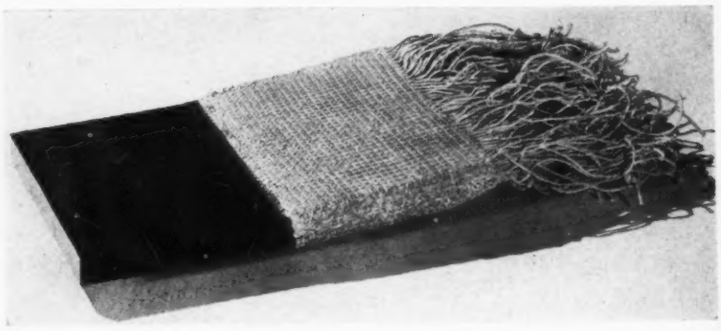
Shull Hydrostatic Scavenger

FOLLOWING tests in wells 8000 ft. and deeper, where, according to the manufacturer, perfect records have been set for recovery of junk, the new Shull Hydrostatic Scavenger is being introduced by the Shull Perforating Company, Inc., 2750 Cherry Avenue, Long Beach, California. Utilizing the differential of pressures at the surface and at the bottom of the well, the tool picks up all junk, according to the engineers of the company. The scavenger is coupled to the lower section of the drill pipe after the drill collar is removed. After being rotated to bottom, the shoe scrapes and gathers junk to the center.

Weight of the string is sufficient to hold the scavenger stationary. A half-turn on bottom turns the valve threads and opens the valve, permitting the junk to be forced up past hinged retainers into the junk basket. The perforated, tapered seat around the valve provides positive action and permits draining so that the string is brought up dry.

Rotary Brake Lining for Oil-Well Drilling

JOHNS-MANVILLE, New York, New York, announces the development of a new type of woven rotary lining in which cabled yarns are used. These asbestos "cables" are woven into a compact mass, impregnated to increase heat resistance and frictional qualities, and then compressed. The result is an unusually efficient and durable lining for heavy-duty work, the manufacturer states.



Asbestos "cables" form the backbone of the new Johns-Manville No. 420 Rotary Lining.

The new lining, known as Style No. 420, is the product of years of research and practical testing of brakes on rotary drawworks used in drilling oil wells. It is applicable to wells of all depths, and is particularly recommended by the makers for deep drilling. A feature of the use of the material is unusually even feed-off, giving better control of drilling. The lining also is designed so that even at the extreme temperatures caused by heavy loads, braking efficiency remains high.

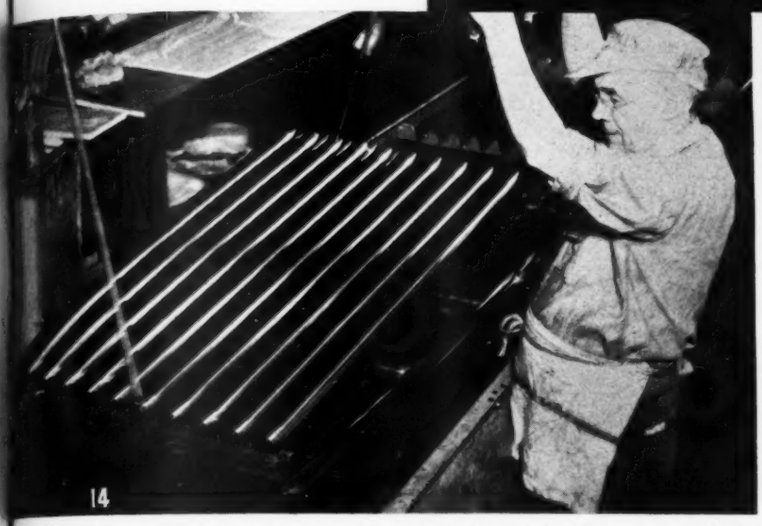
Tests have demonstrated that the lining has long life; its use also reduces the scoring of drums, resulting in more efficient drum service, the manufacturer says.

READY for LIFE
in steady pumping
THE BIRTH OF PLUNGERS AS SEEN BY AXELSON'S CANDID CAMERA . . .

Countless thousands of strokes — plunger against liner, metal to metal, week after week, for months. That's the kind of treatment to which Axelson plungers are subjected and for which they are fitted.

Manufactured from the finest materials under the guidance of one of the ablest engineering staffs in modern industry, Axelson plungers meet any pumping condition.

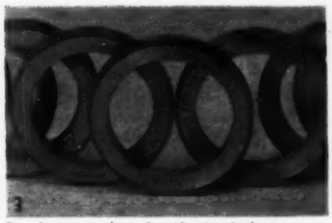
Axelson plungers are working longer in the bottom of more wells than any other plungers made.



After a thorough cleansing in vapor de-greasing machines, Axelson plungers are completely protected by the application of a rust-preventive solution.

Material for Axelson plungers is cut to proper lengths by power hack saws. These lengths are then ready for preliminary heat treatment.

Next, plunger blanks are packed in special containers with carburizing material and then sealed. This operation impregnates surface of plunger blanks with carbon.



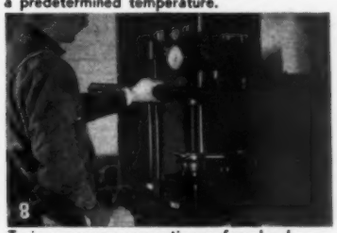
Random samples of carburized plunger stock are checked for case depth to predetermined Axelson specifications. This is but one of a series of tests.

First machining operation in the manufacture of Axelson Super-Service Hardened Steel Plungers is the cutting of the grooves. Grooves are checked for depth.

Carburized surface in ends of plungers is removed by boring. This is done to prevent hardening of the subsequently machined threads.

After these preliminary machining operations, plungers are returned to heat-treating department where hardened surface is produced by heating and quenching.

Plungers are again heated and drawn to relieve internal strains. The drawing operation consists of reheating and cooling at a predetermined temperature.



To insure proper operating surface hardness, each Axelson plunger is carefully checked in a Rockwell hardness testing machine.

Plungers are then returned to machining department where both ends are finish-reamed and threaded to receive plunger fittings.

In order to insure proper adherence to A.P.I. specifications, plunger threads are checked with Go and No-Go thread gauges.

Surfaces of Axelson plungers are accurately finished to correct diameter by grinding. Tolerances are held to within one-quarter thousandth of an inch.

Mirror-finished polish is imparted to Axelson plungers by specially designed machines. This high polish permits smooth action and provides long life.

In the final inspection, Axelson plungers are rigidly checked for surface finish, straightness, concentricity and conformity to size and A.P.I. tolerances.

To avoid the possibility of corrosion induced by handling and exposure, Axelson plungers are immediately packaged in waxed, weather-proof containers.

Complete stocks of Axelson plungers insure rapid service to the industry. Extreme care is exercised in the storage of Axelson plungers.

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

AXELSON

DEEP WELL PLUNGER PUMPS

SUCKER RODS

Axelson Manufacturing Company, P. O. Box 98, Vernon Station, Los Angeles • St. Louis • 50 Church Street, New York • Tulsa

Mid-Continent and Eastern Distributor: Frick-Reid Supply Corporation • *Rocky Mountain Distributor:* Great Northern Tool & Supply Company.

Unibolt Coupling Principle Applied to Adjustable Choke of Improved Design

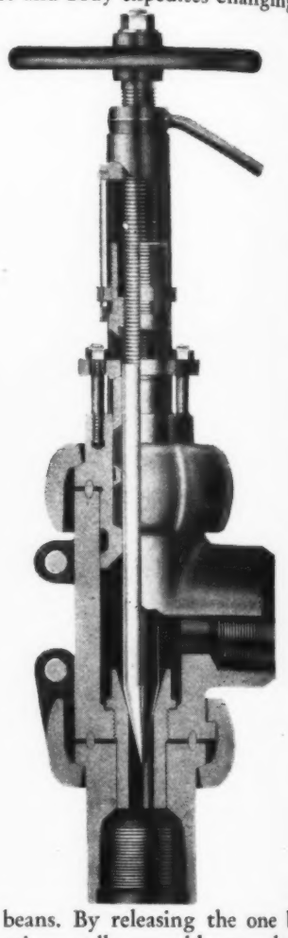
THORNHILL-CRAVER Company, Houston, Texas, manufacturers of Unibolt couplings and fittings, has announced a new adjustable choke, which, according to the manufacturer, presents several unique features.

It is claimed that the Unibolt Adjustable Choke provides greater precision in the control of flow by accurately centering the needle in the orifice, and by providing a more sensitive indicator mechanism.

A regular Unibolt coupling connects the bonnet, or needle assembly, to the choke body, the patented tapered interlocking shelf principle applying equal pressure at all points and holding the needle assembly rigidly in position. The yoke member is piloted into the choke body to serve as a guide for the needle, centering it in the orifice.

According to the manufacturer, all parts are machined to micrometer precision to further assure centering of the needle. A special threading arrangement in the indicator mechanism results in a 2-to-1 ratio of movement between the needle and indicator arm, the indicator arm traveling twice as far on the indicator plate as the needle moves in or out of the orifice. Thus, a coarser, accurate reading is provided, it is pointed out.

The Unibolt coupling between the bonnet and body expedites changing of



flow beans. By releasing the one bolt, the entire needle assembly may be removed. A blanking plug replaces the bonnet in event it is desirable to convert the adjustable choke to a positive type; and because all parts are interchangeable, the bonnet, or needle assembly, may be installed in a choke body to form another adjustable choke. The nuts and metal ring gaskets interchange with those parts of the high-pressure steel Unibolt coupling.

A regular Unibolt coupling is also provided between the choke body and flow nipple, obviating the need of a coupling in the flow line.

For the benefit of operators who demand even greater safety, a cage nipple and positive bean may be installed in the flow nipple of the adjustable choke to provide an adjustable-positive combination. Removal of the adjustable choke bean provides ample clearance for replacing some of the more popular makes of positive beans through the adjustable choke body.

1912
1938
E.M.SMITH COMPANY
A BEAR for WEAR
GRIZZLY POWERFLEX
More than a quarter century of intensive development and manufacture of quality products for the oil industry is the reason for the outstanding performance of these products in this gruelling service. For superior service, longer life, and super economy always specify "Grizzly."
E. M. SMITH COMPANY
600-650 South Clarence Street
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Complete Stocks Maintained in Our Warehouses at: 2311 West Street, Houston, Texas. 1008 S.E. 29th Street, Oklahoma City, Okla. Export Office: Continental Emsco Co., 30 Rockefeller Plaza, New York City
Distributed by Leading Supply Companies
GRIZZLY
Rotary Brake Blocks
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Rotary Hose
"No-Wip" Line Saver
Drill Pipe Protectors
Tubing Protectors
Belting & Mechanical Rubber Goods
GRIZZLY Hi-Quality PRODUCTS

Ensign Natural Gas Filter

THE Ensign Natural Gas Filter, as shown in the accompanying illustration, was designed for installation in the supply line of natural gas engines to filter out any foreign matter that might be present. This filter is so constructed that it may be installed in a vertical or horizontal pipe line. The inlet and the outlet are plainly marked. The filtering element is easily removed for cleaning or replacement.

The Ensign Natural Gas Filter is made in two sizes for installation in 1-in. and 2-in. pipe.

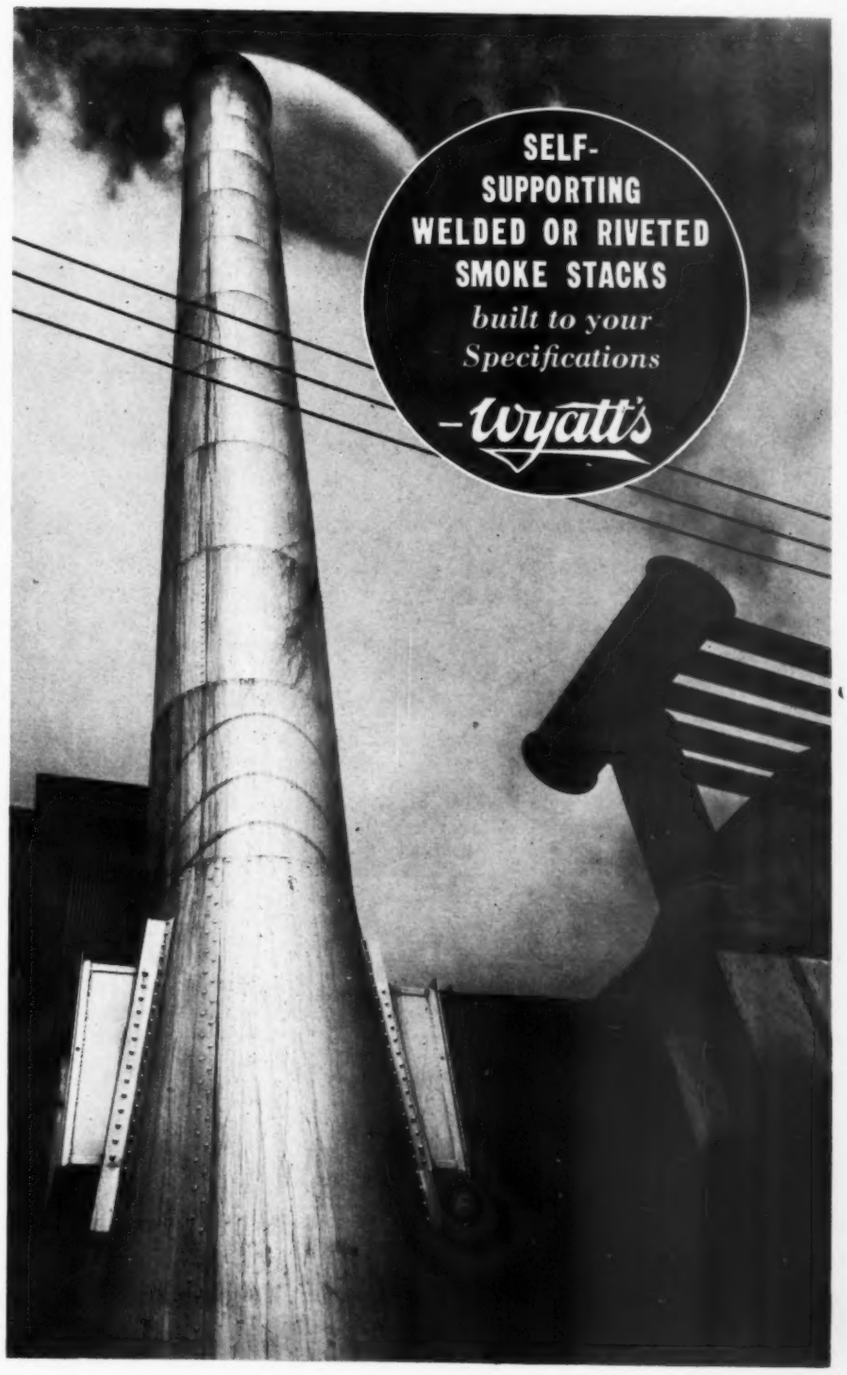
The Ensign Carburetor Company, Ltd., Los Angeles, California, is now offering their new Natural Gas Filter as another addition to their line of natural gas and butane carburetion equipment.

Eastman Oscillating Stuffing Box

A HEAVY-DUTY stuffing box that is said to provide an effective packing and at the same time minimize the wear and tear on the polished rod is now being offered by the Eastman Manufacturing Company, Dallas, Texas. The stuffing box simplifies lining-up the beam on either a straight or crooked hole and definitely indicates whether the rods are centered under actual pumping conditions, the manufacturers state.

The oscillating or reciprocal movement on a horizontal plane within limitations of the tubing diameter permits the packing element to more nearly conform with the vertical position of the polished rod without binding. On crooked holes the oscillating member will travel from one side of the box to the other and return with the up-and-down stroke of the beam. The oscillating member of the unit, because of its freedom of movement, is especially adaptable for pumping wells that have any horizontal play in the walking beam on the up-and-down stroke or show a jerking tendency, it is stated.

The Eastman oscillating stuffing box allows the polished rod to align itself, so it minimizes or eliminates abnormal wear at the point where the polished rod contacts the tubing on either the up or down stroke, the makers state. This helps to eliminate holes worn in the tubing as a result of friction from contact. It also prevents rapid deterioration of packing and reduces the number of broken or crystalized polished rods, it is pointed out.



Lane-Wells Bridging Plug and Production Type Packer

AN outstanding tool is the Lane-Wells Bridging Plug, which is sturdily constructed as a permanent bridge. It may be run into the hole from a stripped derrick, nothing being required other than a place to hang a hook and plug for lowering the bridge into place. In this way it is unnecessary to run tubing back into the hole, pour cement, and do other expensive work. The Lane-Wells Bridging Plug can be run in 30 minutes time.

These bridging plugs are run in and controlled by the Lane-Wells' gun-perforator service units, and a small, electrically-ignited charge of powder, controlled by the operator, breaks a frangible clevis, which, in turn, releases a steel spring, causing the two-way slips to set. This also expands the packing sleeve, freeing the setting head from the plug.

The same accurate measuring and weighing devices used in connection with the gun-perforator are used in setting this bridging plug, assuring positive control and definite depth placement.

This bridging plug will always stay exactly where it is set, the makers state. Excessive pressures either from above or below only tend to set the slips tighter and it has a synthetic rubber packing sleeve that is practically insoluble in oil or gas. This sleeve is automatically expanded against the casing and is provided with lips on both ends, which cause fluid or gas pressure to further tighten the pack-off.

Production Type Packer

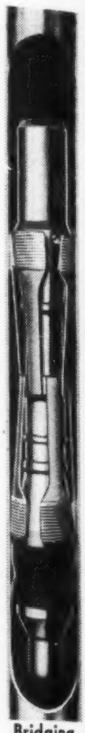
As progress is made in the oil industry more and more uses and advantages of the Lane-Wells Production Type Packer are being recognized; packers may be used with any type of equipment designed to prolong the gas-lift stage of producing wells, the manufacturers state.

The soundness of design of the Lane-Wells packers has been proved by years of service; they have remained set as long as four years under severe temperature conditions, and have withstood maximum pressures without a single instance where the packing element has vulcanized to the casing, it is stated.

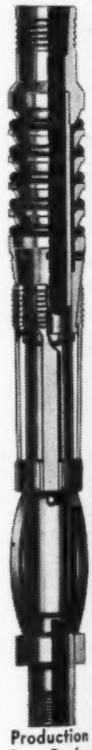
Multiple packing rings are used in the Lane-Wells packer, each consisting of layers of heavy, graphite-impregnated, bias-cut fabric moulded over and around a one-piece rubber core. The layers of fabric prevent vulcanizing to the casing and the rubber core assures elasticity to draw the rings away from the casing when the packer is released. This multiple-ring packing assembly provides five-fold safety in sealing off, thus a perfect pack under high pressures is assured, the makers state.

Where space is available, maximum by-pass area is provided, minimizing swabbing action when running in and out of the hole.

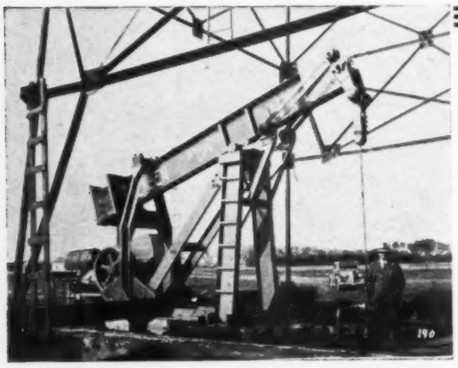
Special packers, designed to meet unusual well conditions, have constituted a substantial part of Lane-Wells Company's business for years, and any inquiry concerning special problems, addressed to Lane-Wells Company at 5610 South Soto Street, Los Angeles, California, will receive prompt and careful consideration.



Bridging Plug



Production Type Packer



THIS UNIT LIFTS OIL FOR LESS!

Every barrel of oil you lift will cost you less with a JENSEN JACK. We've worked to that end for 19 years. Smart producers have helped us. We've got what it takes.

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BROTHERS MANUFACTURING CO.

. . . *Coffeyville, Kansas*

We can tell you what to expect on your own property. You'll be astounded — you'll wonder why the devil you didn't investigate long ago.

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Check your division:
☐ Producing ☐ Refining
☐ Natural Gasoline ☐ Supply ☐ Manufacturing

Apparatus for Procuring and Examining Sub-surface Samples of Oil

CONSIDERABLE interest has been displayed by production engineers in the new Stupakoff Bottom-Hole Sampler, for which the Pittsburgh Equitable Meter Company is sales agent. This apparatus is for obtaining and examining sub-surface samples of oil. A companion product to the Stupakoff Bottom-Hole Pressure Gauge, also sold only through the Pittsburgh Equitable Meter Company, the Sampler and auxiliary apparatus is said to have been thoroughly field-tested for a period of more than two years prior to its first public showing at the International Petroleum Exposition.

The basic instrument consists of the Sampler, essentially a tubular chamber open at both ends with means provided for forcibly closing the ends of the chamber, thus trapping a sample of the fluid. The total length of the device is 61 in., and the diameter is 1¾ in., which permits it to be lowered into tubing as small as 2 inches. The internal passages are designed to offer minimum obstruction to the flow of oil, so that as it is lowered into a fluid column with the valves open, it passes through the fluid without carrying any along to a lower level. The sample chamber, 42 in. in length and 1⅜ in. in diameter, is closed when upper and lower knife-edged valves are thrust against fiber valve seats by spring pressure of approximately 50 lb. actuated by a messenger released from above. The Sampler is used both for obtaining the sample and as the container during its examination.

Auxiliary apparatus designed for use in the field to eliminate time lost in sending samples to the laboratory includes a dead weight tester for measuring pressures, a heater jacket for maintaining samples at a constant temperature during the tests, an accurate gas meter for measuring gas volumes to .0001 cu. ft., a mercury pump for changing the effective volume of the sample chamber by introducing mercury under pressure, and several devices for attaching these to the Sampler.

For further information, write Pittsburgh Equitable Meter Company, 400 North Lexington Avenue, Pittsburgh, Pennsylvania.

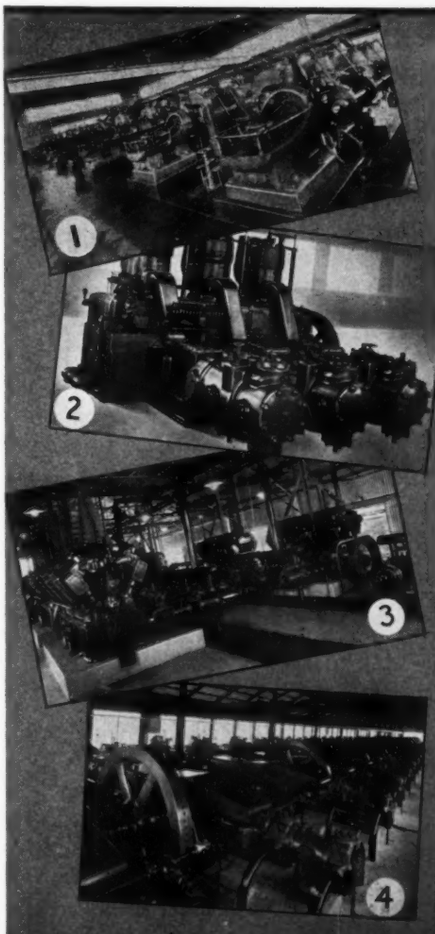
Centrifugal Ejector Pumps

FAIRBANKS, Morse and Company have designed and built a complete line of centrifugal ejector pumps, for pumping water from depths of 150 ft. or less, the primary features of which are simplicity and economy.

These units require no lubrication and have no moving parts below surface except a foot valve. They are offered either with motor-driven or V-belt-driven heads. Pressure tanks are offered as optional and, although the engine-driven units are manually operated, the electric motor-driven units can be ordered with automatic start-stop pressure switch. With the elimination of the ejector feature from these units, an efficient, vertical centrifugal pump for shallow wells is obtained.

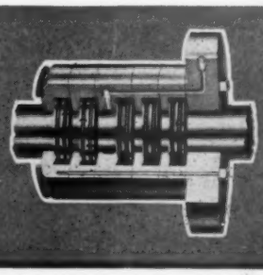
More complete and detailed information can be had from The Continental Supply Company, Dallas, Texas, which is the exclusive distributor of Fairbanks-Morse equipment to the oil industry.

Seal your reciprocating piston rods
the way so many engine and compressor operators do... with
COOK'S METALLIC PACKINGS



Wherever you may look throughout the oil and gas fields you will find COOK'S Metallic Packings predominating on the power and compressor rods of gas pumping and gasoline extraction engines. Noteworthy applications are represented by the engines, shown in the accompanying illustrations, that come factory equipped with COOK'S modern Packings.

Make sure you get the genuine COOK'S Packings when buying new equipment by specifying their use. For existing equipment communicate with us direct, or our nearest branch office.



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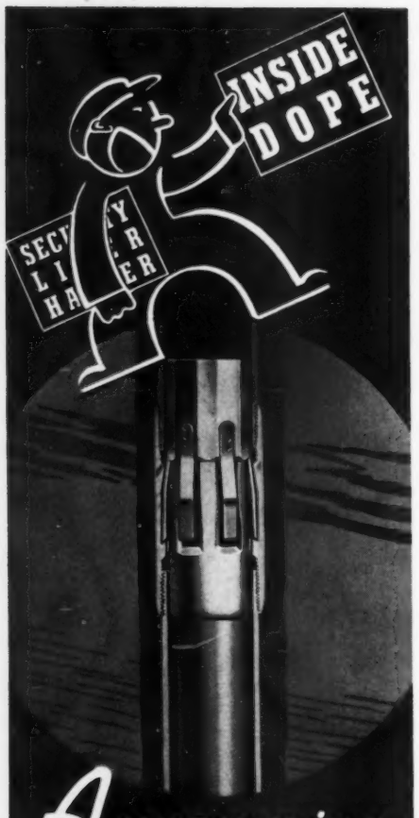


Announcing

An amazing new LINER HANGER that works AUTOMATICALLY!

The Security Hook Collar Liner Hanger is radically different from any liner hanger you ever saw before...

- It sets *automatically* without twisting or turning the run-in string.
- It has no slips to jam or freeze in the casing.
- It positively cannot be set too high or too low in the hole.
- It won't slip down the casing under the heaviest liner loads.
- It releases with only a straight pull.
- It is available in steel or "SECURALOY"—the drillable material.

It's amazingly simple, absolutely foolproof, and completely dependable, and is field-proven in hundreds of installations.

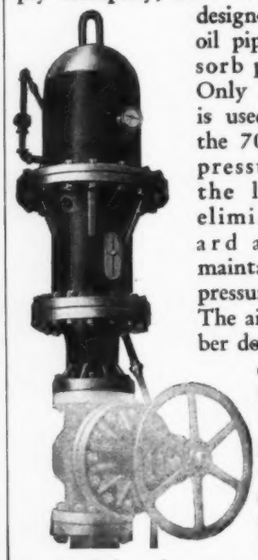
Write today for illustrated bulletin giving full details!

SECURITY ENGINEERING CO., INC.
WHITTIER, CALIFORNIA
Export: Security Engineering Co., Inc., 420 Lexington Ave., N. Y. C.

Sievers Reamers • • • Securaloy • Security Drillable Products •

Safety Surge Chamber for Pipe Lines

THE new safety surge chamber announced by Mid-Continent Supply Company, Fort Worth, Texas, is designed for use on oil pipe lines to absorb pump surges. Only 100 lb. of air is used to cushion the 700 lb. of fluid pressure carried in the line and to eliminate the hazard and cost of maintaining a high-pressure air system. The air in the chamber does not come in contact with fluid at any time. The principle of design is the same as that used in balloon tires for automobiles—low-pressure cushion. It is necessary to replace air at long intervals only as the air is held in a separate chamber.

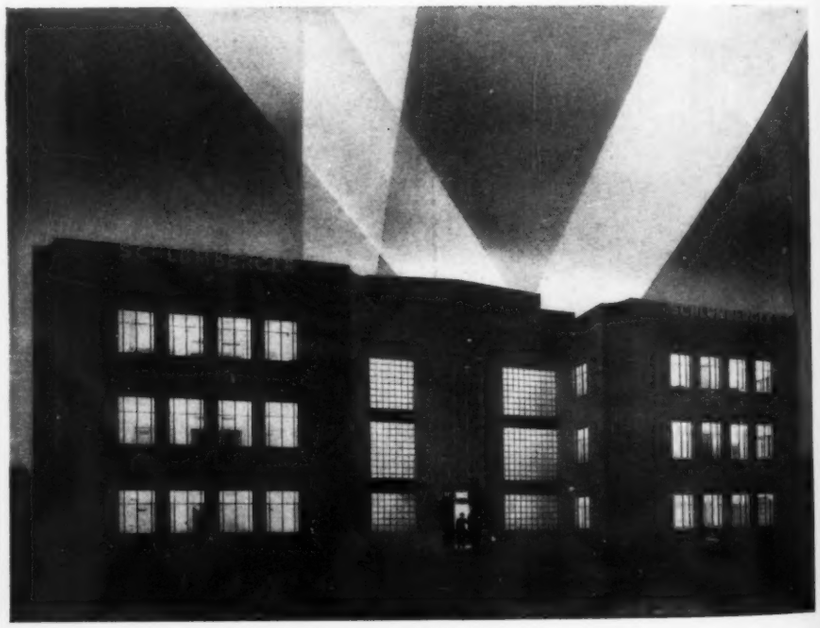


The chamber, according to the manufacturer, offers these special features: It is automatic, requiring no attention when shutting-down or starting pumps. It is safe. Oil and air do not come in contact with each other. It is economical as there is no high-pressure air system to maintain and no intricate parts. It is durable, made to withstand severe shocks. It is dependable, eliminating fire hazards.

Oil-Well Chain for Deep Drilling

A NEW precision oil-well chain for deep drilling, built of heat-treated alloy steels to the standards of the American Petroleum Institute, is announced by the Jeffrey Manufacturing Company, Columbus, Ohio. This new chain, introduced under the trade name "Devil Dog", in the A.P.I. No. 4 size weighs 16.3 lb. per ft. and has an ultimate strength of 170,000 pounds. In this chain elongation caused by initial "breaking-in" wear is eliminated in the factory by fine finishing of the bearing surfaces to accurate measurements, the makers state. Side bars are drop-forged and ribbed, pins are centerless ground and cadmium plated, bushings are machined from solid bar and centerless ground inside and out, and rollers are machined from solid stock. This same chain also is supplied in A.P.I. No. 3 size, having an ultimate strength of 75,000 lb. and a weight of 8.3 lb. per foot.

New Schlumberger Building Formally Opened



Schlumberger Well Surveying Corporation's new headquarters building at 2720 Leeland Avenue, Houston, Texas, was formally opened June 25th. Several hundred friends and clients of the Schlumberger oragnization attended "open house" to help celebrate the occasion. The new building, which contains 40,000 sq. ft. of floor space, all air-conditioned, is ultra-modern in every respect.

Trade Personals

W. C. TROUT, president of the Lufkin Foundry and Machine Company, Lufkin, Texas, and A. V. SIMONSON, export manager, sailed on the S.S. Nieuw Amsterdam June 10th for an extended business trip abroad. They will visit Holland, Germany, France, England, and possibly Italy.

* * *

A. E. ASHCRAFT, Fairbanks, Morse and Co. vice-president in charge of manufacturing, has announced the appointment of A. C. HOWARD to the position of general manager of the company's Beloit, Wisconsin, plant. This position formerly was held by Ashcraft in addition to his executive control of all Fairbanks-Morse factories in the United States and Canada. Howard has been assistant general manager of the Beloit plant for six years.

* * *

HYMAN LEDEEN, 747 Warehouse Street, Los Angeles, California, has been appointed sales representative in the lower part of the state of California, the states of Arizona and New Mexico, and the western part of the state of Texas for the Struthers-Wells Titusville Corporation.

* * *

W. K. MELLON, vice-president in charge of sales and service in all territories for the Petroleum Rectifying Company of California, Los Angeles, recently returned from a business trip to the Gulf Coast district and left shortly thereafter for a more extended trip through the eastern and Great Lakes sections. He was scheduled to meet GORDON B. HANSON, district manager, and L. C. WATERMAN, district engineer, both of the Houston office, in Chicago, from which point his itinerary eastward includes Pittsburgh, Philadelphia, New York City, and Cleveland. On the return trip Mellon may also visit Buffalo and Montreal, returning to headquarters via the southern route and stopping for a short visit at the Houston branch.

* * *

J. B. O'CONNOR, Clark Brothers Company, Olean, New York, is joining his family at Banff, Lake Louise, to drive with them to Vancouver Island, B. C., where the family will spend the summer.

J & L Opens Wire Rope Plant

ROBERT GILMORE

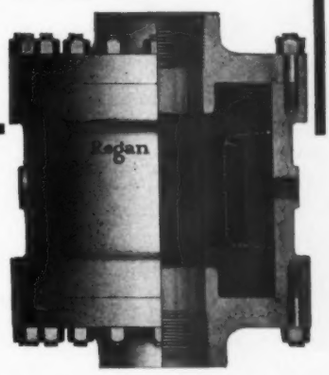
The completion of a modern wire rope plant at Muncy, Lycoming County, Pennsylvania, as an additional unit of its expansion and development program has been announced by the Jones and Laughlin Steel Corporation, Pittsburgh.

This new plant, to be known as the Gilmore Wire Rope Division of the Jones and Laughlin Steel Corporation, began operation July 1st. It marks the entry of the corporation into a new line of finished products including wire rope for oil country use, for general construction purposes, and for industrial application.

The fabrication and sale of the products of the new plant are to be under the direction and supervision of Robert Gilmore, general manager, whose offices will be at Muncy, Pennsylvania.

DRILL

AGAINST PRESSURE



REGAN TYPE K BLOWOUT PREVENTER

Normally open to full size of casing, can be instantly closed by remote control to pack off the opening around any size or shape of pipe, kelly or tool likely to require such packoff. Makes an unrivalled stripper. Operated double or single.... Ask for Bulletin or see Composite Catalog.

Regan
Forge & Engineering Co.

Plant and General Offices — San Pedro, Cal. P. O. Box 150

Mid-Continent Office—1502 Maury Street, Houston
Oklahoma—Mid-Co Tool & Supply Co., Oklahoma City
Kansas Representative—Bovaird Supply Co., Wichita
New York City Office—17 Battery. G. R. Woods, Mgr.

Can You Spell
"DEPENDABILITY"
***in* FIVE LETTERS?**

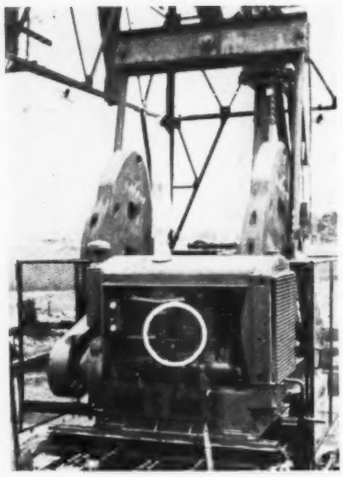
H-O-U-G-H spells dependability, when it comes to working barrel valves . . . and strict economy, too. It *pays* to specify Hough. For safety's sake, use the Hough "Protex" Upper Valve, illustrated. The Charles N. Hough Mfg. Company, Franklin, Pa., and Tulsa, Okla.

HOUGH
Working Barrel Valves

LEADING ENGINE BUILDERS CHOOSE **ENSIGN**

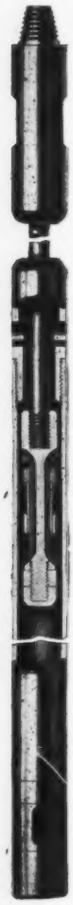
Standard equipment with approximately 90% of the leading engine manufacturers, ENSIGN Carburetors help assure the dependability and economy of engine operation so necessary in severe oil field service.

ENSIGN Gas, Combination Gas and Gasoline and Butane Carburetors are noted the world over for quality and efficiency. For well servicing, drilling, pumping, auxiliary equipment and all other engine uses be sure its ENSIGN —for best results!



MINNEAPOLIS-MOLINE Oil Field Engines have proved their economy and dependability for the past 20 years for oil producing companies throughout the industry. Above is shown an MM pumper operated on Natural Gas with an ENSIGN Carburetor and Fuel Regulator.

ENSIGN CARBURETOR CO., LTD.
LOS ANGELES · OAKLAND · CHICAGO



You'll get results with the SHULL self-unloading
SAND PUMP

Revolutionary developments in the construction of this self-unloading sand pump eliminate difficulties of de-sanding operations and cut down bailing time. Spudding three or four times fills the extra-long bailing tube and it will not stick in the casing. Instantly unloaded, the fluid in the bailer washes sand chamber clean. Greater strength, added weight, 11-foot plunger stroke and 28 feet of actual load chamber make this the first trouble-free, self-unloading pump on the market.

The New Shull Catalog
Tells All About It.
Request a Copy

Shull Perforating Co., Inc.
2750 Cherry Avenue Long Beach, California

TRADE LITERATURE

In a New 20-page Engineering Data Book, Johns-Manville has made available full information on the J-M line of refractory products, including cements, castables, and plastics. The descriptive material includes data on the character or base of each product, its highest working temperature, the number of pounds needed to set 1000 brick or form one cu. ft. of construction, and the form in which the product is supplied. The book's most valuable feature, one that will be definitely helpful to the operators of power plants, oil refineries, gas and coke plants, steel mills, lime and cement kilns, iron foundries, furnaces in the non-ferrous metal industries, glass-making equipment, ceramic kilns, incinerators, and domestic oil burning and stoker installations, is a comprehensive table that lists separately the various types of heated equipment used in these different industries. For each piece of equipment, the table describes the parts requiring a refractory cement and recommends a specific product for the job. Copies of the book, Form DS Series 700, are available upon request to Johns-Manville, 22 East Fortieth Street, New York City.

Hughes Tool Company Wins Two Infringement Cases

On July 1, 1938, the United States Circuit Court of Appeals for the tenth circuit at Denver, Colorado, handed down two decisions in favor of Hughes Tool Company in the cases of Chicago Pneumatic Tool Company vs. Hughes Tool Company and Southwestern Tool Company vs. Hughes Tool Company. The Chicago Pneumatic Tool Company case was an appeal from a decision of the District Court of the United States for the Western District of Oklahoma, it being a suit brought by Hughes Tool Company alleging infringement of its Patent No. 1647753.

The Circuit Court, speaking through Judge Bratton, held that the patent was valid and infringed by the Chicago Pneumatic Tool Company. The Chicago Pneumatic Tool Company contended that rock bits of its manufacture did not infringe on the patent inasmuch as the teeth on the Chicago Pneumatic cones did not interfit with the rows of teeth on adjacent cones, but the Court held that it was not necessary that the rows of teeth interfit in order to constitute infringement, as the patent described not the interfitting teeth but the shape and form of the teeth on the cone; that is . . . "long, narrow, chisel-shaped, penetrating teeth arranged in circumferential rows around the cone . . . and the drawings and specifications do not present warrant or occasion for limiting the patent to a structure having interfitting teeth."

With respect to infringement on the part of the Chicago Pneumatic Tool Company, the court held that ". . . the departures from the claims in respect to the shape and form of the teeth are colorable and without change in principle. As such they do not avoid infringement. The departure from the disclosure of the patent is merely colorable. . . . An insubstantial departure from the patent without change in principle does not avoid infringement."

The decree of the United States District Court for the Western District of Oklahoma restraining the Chicago Pneumatic Tool Company from further infringement and ordering an accounting was affirmed.

In the Southwestern Tool Company case there was in-

volved the question as to whether acts done by the Southwestern Tool Company were permissible repair or whether such acts were a reconstruction and infringement of three Hughes Tool Company patents. The facts showed that the Southwestern Tool Company reconstructed teeth by welding. This work was done on worn cones manufactured by the Hughes Tool Company.

The court said: "The defendants . . . add new teeth to the cutters. They furnish parts that are specifically covered by the patents and then sell the cones for reuse. That is well outside the domain of permissible repair and restoration and plainly constitutes infringement."

The Circuit Court also held that the president of the defendant corporation was jointly liable with the corporation for the damages resulting from the wrongful acts of infringement; inasmuch as it was shown that he "participated in the acts of infringement; and that he used the corporation as an instrument to carry out his own infringement."

In this case the decree of the United States District Court for the Western District of Oklahoma restraining further infringement on the part of Southwestern Tool Company and ordering an accounting was affirmed.

G. E. Seaberg with Pittsburgh Equitable Meter

G. E. SEABERG

George E. Seaberg has been appointed sales manager of the coupling and fitting division of the Pittsburgh Equitable Meter Company, Pittsburgh, Pennsylvania. Seaberg's long experience makes him well qualified to head this newly-created department. For the last 12 years he was associated with the S. R. Dresser Manufacturing Company as manager of their water works division, and prior to that was with the Peoples Gas Light and Coke Company of Chicago in an engineering capacity.

John Talley with Jensen Brothers

JOHN TALLEY

John Talley has been appointed a district representative of Jensen Brothers Manufacturing Company, Coffeyville, Kansas. His territory covers part of East Texas, Northern Louisiana, and Arkansas. His headquarters are at Atlanta, Texas.

Talley has been connected with supply companies in the Mid-Continent since 1920 and was formerly with Frick-Reid Supply Corporation at Haynesville, Louisiana, and the Bridgeport Machine Company in East Texas and Rodessa, Louisiana.

PATENT NO. 2027783

B-M-W Admore

Insert Pump Anchor

The

First Choice

of Those Best Qualified to Choose Oil Well Equipment

PAYS for itself quickly.

SAVES expense of pulling tubing.

SAVES on sucker rods and other equipment where fluid level is high and well can be pumped above bottom.

ELIMINATES necessity of other seating means such as working barrels, seating nipples, or mechanical shoes.

SEATS your insert pump by packing off and holding down directly in the tubing itself.

SCREWS directly onto the pump and replaces the conventional cup or mechanical hold-down. The pump is run in the usual way with no special care required.

Complete Data on Request

B-M-W PRODUCTS are obtainable at SUPPLY STORES

● NEILSON TOOLS (Safety Sucker Rod Hooks; Tubing Hooks, Rod Elevators, Sucker Rod Sockets, etc.); ● BALLS and SEATS (made for every pumping service); ● ADMORE Liner Barrels; ● TEX TYPE Plunger Fittings and Valves; ● COLLINS Belt Clamps, and ● ADMORE Insert Pump Anchors.

BRADFORD MOTOR WORKS INC.

OIL WELL SUPPLIES

BRADFORD, PA. — TULSA, OKLA.

Look for the Arm-and-Hammer

ARMSTRONG BROS.

Better PIPE TOOLS

Built to industrial standards for quality tools these are better pipe tools, improved in design and action with drop forgings, alloy steels, and hardened parts wherever they will add to performance or life. Handier, stronger, accurately made and finely finished, they make work easier, faster. They comprise the most complete line made, still each is an *improved* tool. The Chain Vise has drop-forged 1-piece (patented) jaws that prevent crushing or bending of smallest pipe, tubing or conduit ... the patented pipe wrench has forged-in-lugs that absorb all side strain and nine other features—etc.

The most complete line of pipe tools made.

Solid Dies and Stocks (3 types)
Adjustable Dies and Stocks
Receding Type Threaders (3 types)
Pipe Cutter with Knife Blade Wheels (5 types)
Standard Chain and Post Vises
Chain Wrenches and Tongs (5 types)
Pipe Wrenches
Ratchet Reamers

WRITE FOR CATALOG P-35

ARMSTRONG BROS. TOOL CO.
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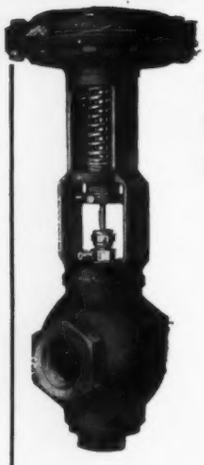

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Death of George E. Emmons

George E. Emmons, formerly manager of the Schenectady Works of the General Electric Company and later vice-president in charge of manufacturing for the company, died in Pasadena, California, July 1. Burial was at Pasadena July 6.

Emmons, who devoted more than a quarter century directing the development of one of the world's largest electrical plants as general manager of the Schenectady works, was born in Westchester, Connecticut, September 9, 1857.

H. M. Cooley to Staff of Bethlehem Steel Company

H. M. COOLEY

Herbert Mains Cooley, Tulsa, Oklahoma, has become connected with Bethlehem Steel Company as manager, field engineering, tubular products. His work will be principally the development of oil-country tubular products. He will reside at Tulsa, Oklahoma, where he will be connected with the Bethlehem Supply Corporation, G. A. Tompson, vice-president.

Cooley was formerly with National Tube Company in the capacity of field engineer. He is a graduate of Carnegie Institute of Technology, a member of the Engineers' Club of Tulsa, and the American Petroleum Institute.

O. A. Haas On Trip to South America

O. A. HAAS

O. A. Haas, Tulsa district manager of the Allis-Chalmers Manufacturing Company, left Tulsa the week of June 6th to 11th, on a business trip to South America. Haas will be gone approximately three months, after which he will return to Tulsa. During Haas' absence, R. I. Moore is acting manager of the Tulsa district office.

From New York to Los Angeles for Air-Maze

E. B. TREIDLER

E. B. Treidler, well known among industrial equipment buyers in New York and California, is now special representative for Air-Maze Corporation, covering Southern California and Arizona. He is representing the complete line of Air-Maze air filters for oil-field engine and air compressor applications.

Until a few months ago Treidler was connected with the Alpha Steam Specialty Company, New York City, an Air-Maze distributor. There he became impressed with the possibilities of handling the Air-Maze line in California, his "home territory", where he had formerly spent many years working with industrial accounts.

Accordingly, when the Harvey L. Laughlin Company of 1315 E. 7th Street, Los Angeles, was recently appointed factory representative for Air-Maze, Treidler joined them to take charge of the Air-Maze account.

Methods For the Determination of Salts in Crude Oils

The Petroleum Rectifying Company of California, lessors of the Petreco Electromatic De-Salting Process, recently have been carrying some interesting articles on the "Determination of Salts in Crude Oils," in their house publication, "The Electric Dehydrator." These articles are written by C. H. M. Roberts and R. W. Stenzel, two members of the Petreco technical staff, who have devoted considerable time to the subject.

These articles doubtless will prove of considerable value to refinery operators and technicians. Copies may be obtained free by addressing Petroleum Rectifying Company of California, 530 West Sixth Street, Los Angeles, California.

Axelson Employees' Picnic

Employees of Axelson Manufacturing Company held their Ninth Annual Picnic June 25 at Montebello American Legion Stadium in Los Angeles, California. Heading a diversified program of games, contests, and dancing, Ray M. Humphreys, assistant director of sales, master-ceremonied the entertainment of the 1300 employees and visitors present. Assisting him were Charles Jeffries and a committee of seventeen.

C. F. Camp Dies Following Operation

C. F. Camp, Tulsa, Oklahoma, head of the C. F. Camp Company, secretary-treasurer of the Arrow Drilling Company, and an active independent oil producer, died July 11 in a Tulsa hospital. A few days previously a leg, originally injured while playing football 25 years ago, had been amputated. Camp was well known and extremely popular in the oil industry.

C. F. CAMP

Born in Roanoke, Virginia, 43 years ago, Camp enlisted in the United States Army during the World War, becoming a sergeant in the engineering corps. After the war he moved to Tulsa and entered the oil business with the Keystone Lubricating Company. He soon formed his own company, however, the C. F. Camp Company, distributors of oilfield supplies. He was active in affairs of the industry and was a member of the board of directors of the International Petroleum Exposition.

Camp is survived by his widow, a daughter, Mary Ann, and a son, Charles F. Camp, Jr.

Jack S. Mellon Passes Away

Jack S. Mellon, foreign sales manager for Byron Jackson Company, Los Angeles, California, was taken by death the latter part of June.

Mellon was born in Toronto, Canada, July 24, 1887, but his family moved to California when he was still quite young. He attended high school and business college in Pasadena. Mellon was engaged in the wholesale machinery business until 1919 when he joined the staff of the Dunn Manufacturing Company. Subsequently he became sales manager of that company, a post he held until the company was merged with the Byron Jackson Company in 1928. He was placed in charge of foreign sales for the expanded organization.

Mellon's work took him throughout the world and he was widely known in all foreign oil countries as well as in the United States.

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- **BAILER BOTTOM** — With the Bailer Bottom installed the MILLER is quickly changed to a Bailer giving you a combination of either Bailer or a Sand Pump in one tool.
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- **CHISEL BOTTOM** (In Pump) — With this bottom tightly packed sand can be easily broken in small pieces so it can be picked up in the pump.

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See Page 1445 COMPOSITE CATALOG

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THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT NO. 14

For the convenience of readers who wish to refer to the tables, each page carries in the upper right corner an index number that classifies the table according to subject matter.

All petroleum engineering literature may be indexed for reference according to the Dewey Decimal System as modified and extended for the petroleum industry by L. C. Uren, professor of petroleum engineering at the University of California. When classified according to these index numbers the material follows in a logical sequence and falls into several natural divisions, as illustrated by the following outline:

Nos. P000-P399—General

Nos. P400-P499—Drilling

Nos. P500-P599—Production

Nos. P600-P699—Transportation and Storage (includes Pipe Line)

Nos. P700-P799—Refining, including

Nos. P770-P799—Natural Gasoline, which may be classified in a separate division (as shown here) if of special interest to the user.

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A REGULAR FEATURE OF THE PETROLEUM ENGINEER

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Staynew Filter Corporation	126	June	P 615.108.30
Westinghouse Electric & Mfg. Company	134	June	P 094.14

TOTAL[1] UPWARD PRESSURE AT WELL HEAD BETWEEN DRILL PIPE AND CASING, LB.

Casing diam., O.D., in.	Drill pipe diam., O.D., in.	Well head pressure, lb. per sq. in. gauge																	
		1000	2000	3000	3500	4000	4500	5000	5500	6000	6250	6500	6750	7000	7200	7400	7600	7800	8000
18⅝	2⅜	245,960	491,910	737,870	860,850	983,820	1,106,800	1,229,780	1,352,760	1,475,740	1,537,220	1,598,710	1,660,200	1,721,690	1,770,880	1,820,070	1,869,270	1,918,460	1,967,650
	2⅞	243,890	487,790	731,680	853,630	975,580	1,097,520	1,219,470	1,341,420	1,463,360	1,524,340	1,585,310	1,646,280	1,707,260	1,756,040	1,804,820	1,853,590	1,902,370	1,951,150
	3½	240,760	481,530	722,300	842,680	963,060	1,083,440	1,203,820	1,324,210	1,444,590	1,504,780	1,564,970	1,625,160	1,685,360	1,733,510	1,781,660	1,829,810	1,877,970	1,926,120
	4½	234,480	468,960	703,450	820,690	937,930	1,055,170	1,172,410	1,289,650	1,406,890	1,465,510	1,524,130	1,582,750	1,641,370	1,688,270	1,735,170	1,782,060	1,828,960	1,875,860
	5⅛	226,080	452,160	678,240	791,280	904,320	1,017,360	1,130,400	1,243,440	1,356,480	1,413,000	1,469,520	1,526,040	1,582,560	1,627,780	1,672,990	1,718,210	1,763,420	1,808,640
	6⅝	215,910	431,830	647,740	755,700	863,660	971,610	1,079,570	1,187,530	1,295,480	1,349,460	1,403,440	1,457,420	1,511,400	1,554,580	1,597,760	1,640,950	1,684,130	1,727,310
	7⅝	204,720	409,440	614,170	716,530	818,890	921,250	1,023,610	1,125,970	1,228,330	1,279,510	1,330,690	1,381,870	1,433,050	1,474,000	1,514,940	1,555,890	1,596,830	1,637,780
	8⅝	191,960	383,920	575,880	671,860	767,840	863,820	959,800	1,055,780	1,151,760	1,199,750	1,247,740	1,295,730	1,343,720	1,382,110	1,420,500	1,458,900	1,497,290	1,535,680
20	2⅜	284,800	569,600	854,390	996,790	1,139,190	1,281,590	1,423,990	1,566,390	1,708,790	1,779,990	1,851,190	1,922,390	1,993,590	2,050,550	2,107,510	2,164,460	2,221,420	2,278,380
	2⅞	282,740	565,470	848,210	989,580	1,130,940	1,272,310	1,413,680	1,555,050	1,696,420	1,767,100	1,837,780	1,908,470	1,979,150	2,035,700	2,092,250	2,148,790	2,205,340	2,261,890
	3½	279,610	559,210	838,820	978,620	1,118,430	1,258,230	1,398,040	1,537,840	1,677,640	1,747,540	1,817,450	1,887,350	1,957,250	2,013,170	2,069,090	2,125,010	2,180,930	2,236,860
	4½	273,320	546,650	819,970	956,630	1,093,300	1,229,960	1,366,620	1,503,280	1,639,940	1,708,280	1,776,610	1,844,940	1,913,270	1,967,930	2,022,600	2,077,260	2,131,930	2,186,590
	5⅛	264,920	529,840	794,770	927,230	1,059,690	1,192,150	1,324,610	1,457,070	1,589,530	1,655,760	1,721,990	1,788,220	1,854,450	1,907,440	1,960,420	2,013,410	2,066,390	2,119,380
	6⅝	254,760	509,510	764,270	891,650	1,019,020	1,146,400	1,273,780	1,401,160	1,528,540	1,592,220	1,655,910	1,719,600	1,783,290	1,834,240	1,885,190	1,936,150	1,987,100	2,038,050
	7⅝	243,560	487,130	730,690	852,470	974,260	1,096,040	1,217,820	1,339,600	1,461,380	1,522,280	1,583,170	1,644,060	1,704,950	1,753,660	1,802,370	1,851,090	1,899,800	1,948,510
	8⅝	230,800	461,600	692,410	807,810	923,210	1,038,610	1,154,010	1,269,410	1,384,810	1,442,510	1,500,210	1,557,910	1,615,610	1,661,770	1,707,930	1,754,100	1,800,260	1,846,420
21⅓	2⅜	332,430	664,860	997,290	1,163,510	1,329,720	1,495,940	1,662,160	1,828,370	1,994,590	2,077,690	2,160,800	2,243,910	2,327,020	2,393,500	2,459,990	2,526,480	2,592,960	2,659,450
	2⅞	330,370	660,740	991,110	1,156,290	1,321,480	1,486,660	1,651,840	1,817,030	1,982,210	2,064,810	2,147,400	2,229,990	2,312,580	2,378,660	2,444,730	2,510,800	2,576,880	2,642,950
	3½	327,240	654,480	981,720	1,145,340	1,308,960	1,472,580	1,636,200	1,799,820	1,963,440	2,045,250	2,127,060	2,208,870	2,290,680	2,356,130	2,421,580	2,487,020	2,552,470	2,617,920
	4½	320,960	641,910	962,870	1,123,350	1,283,830	1,444,310	1,604,780	1,765,260	1,925,740	2,005,980	2,086,220	2,166,460	2,246,700	2,310,890	2,375,080	2,439,270	2,503,460	2,567,660
	5⅛	312,560	625,110	937,660	1,093,940	1,250,220	1,406,500	1,562,780	1,719,050	1,875,330	1,953,470	2,031,610	2,109,750	2,187,880	2,250,400	2,312,910	2,375,420	2,437,930	2,500,440
	6⅝	302,390	604,780	907,170	1,058,360	1,209,560	1,360,750	1,511,940	1,663,140	1,814,330	1,889,930	1,965,530	2,041,130	2,116,720	2,177,200	2,237,680	2,298,160	2,358,630	2,419,110
	7⅝	291,200	582,390	873,590	1,019,190	1,164,790	1,310,390	1,455,980	1,601,580	1,747,180	1,819,980	1,892,780	1,965,580	2,038,380	2,096,620	2,154,860	2,213,100	2,271,340	2,329,580
	8⅝	278,440	556,870	835,300	974,520	1,113,740	1,252,960	1,392,180	1,531,390	1,670,610	1,740,220	1,809,830	1,879,440	1,949,040	2,004,730	2,060,420	2,116,110	2,171,790	2,227,480
24⅓	2⅜	438,580	877,170	1,315,760	1,535,050	1,754,340	1,973,630	2,192,920	2,412,220	2,631,510	2,741,160	2,850,800	2,960,450	3,070,100	3,157,810	3,245,530	3,333,250	3,420,960	3,508,680
	2⅞	436,520	873,050	1,309,570	1,527,830	1,746,090	1,964,350	2,182,620	2,400,880	2,619,140	2,728,270	2,837,400	2,946,530	3,055,660	3,142,970	3,230,270	3,317,570	3,404,880	3,492,180
	3½	433,390	866,790	1,300,180	1,516,880	1,733,580	1,950,270	2,166,970	2,383,670	2,600,360	2,708,710	2,817,060	2,925,410	3,033,760	3,120,440	3,207,120	3,293,790	3,380,470	3,467,150
	4½	427,110	854,220	1,281,330	1,494,890	1,708,440	1,922,000	2,135,560	2,349,110	2,562,670	2,669,440	2,776,220	2,883,000	2,989,780	3,075,200	3,160,620	3,246,040	3,331,470	3,416,890
	5⅛	418,710	837,420	1,256,130	1,465,480	1,674,840	1,884,190	2,093,540	2,302,900	2,512,250	2,616,930	2,721,610	2,826,290	2,930,960	3,014,700	3,098,450	3,182,190	3,265,930	3,349,670
	6⅝	408,540	817,090	1,225,630	1,429,900	1,634,170	1,838,440	2,042,720	2,246,990	2,451,260	2,553,390	2,655,530	2,757,670	2,859,800	2,941,510	3,023,220	3,104,930	3,186,640	3,268,340
	7⅝	397,350	794,700	1,192,050	1,390,730	1,589,400	1,788,080	1,986,760	2,185,430	2,384,110	2,483,440	2,582,780	2,682,120	2,781,460	2,860,930	2,940,400	3,019,870	3,099,340	3,178,810
	8⅝	384,590	769,180	1,153,770	1,346,060	1,538,360	1,730,650	1,922,940	2,115,240	2,307,530	2,403,680	2,499,830	2,595,980	2,692,120	2,769,040	2,845,960	2,922,880	2,999,790	3,076,710

The fact that total well head pressures for unit pressures as high as 8000 lb. per sq. in. are included in the table should not be interpreted as indicating that the casing will have sufficient bursting strength to withstand such pressure. For bursting strength of casing see Table P432.2, p. 257, August, 1937, issue.

[1]Total for lightest weight casing, hence a maximum for each size casing.

AN OL' TIMER *Reminisces*—

YEP, I REMEMBER way back when the oil industry was just a pup. It's growed a heap since those days and as I sort of look back now and take inventory of myself, I guess I must have growed along with it.

Why I remember when my boss first designed me. He figgered the industry needed a strong, safe tool that would run through a mighty small diameter casing and then would enlarge the open hole below the pipe to a sight larger diameter . . . and he really turned the trick. Just look at me now, why by using only 6 bodies, I have a reamin' range of from 4" to 36" . . . *and that's some reamin'*. As I remember it they had quite a time of namin' me. But finally they christened me the "Baker Rotary Wall Scraper." Somehow that name just stuck and I've been sort of proud of the fact that I was the first tool of my type to be called a "Wall Scraper." Of course they have improved me a lot since the early days. One of the first things they did was to fix me up with one of those Circulation Screens. Yep, it was the first time a tool like myeslf was designed with one of those thingamajiggs. Then, of course, they studied various types of alloys and picked the one to make me out of that was *strong, tough* and *wear resistant*. They fixed it so's my blades positively open and close . . . no chance to get me stuck down in a hole. And say, speaking of blades, they really wear. It's sort of a secret but I'll tell you why (the blades are hard-faced with this here borium stuff which sure gives 'em long life) . . . and they're easy to change too . . . only takes a few minutes.

It seems like every year the boys in the field find a new use for me and while I'm not much of a hand to do a lot of braggin', I am kept mighty busy helping to—

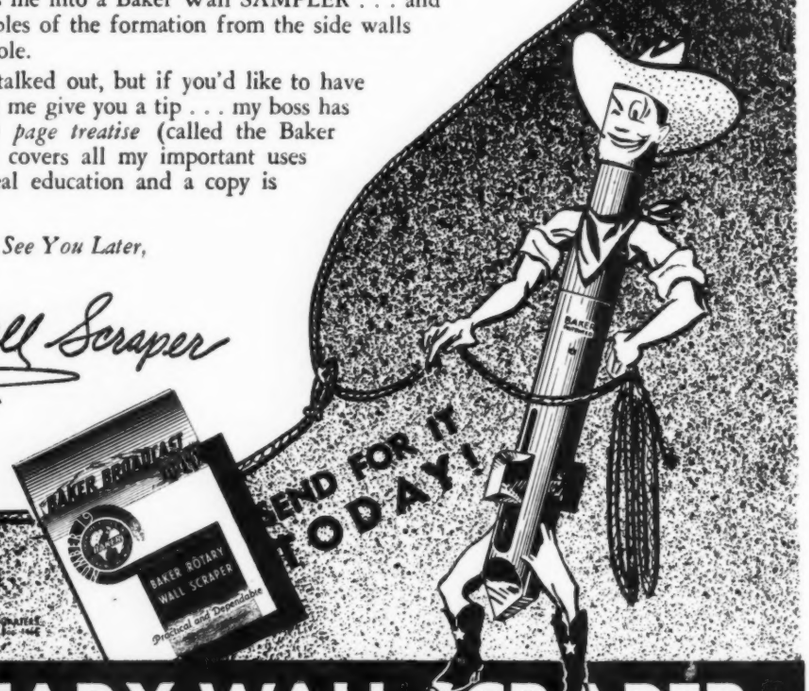
Clean Up Oil Sands • Set Liners • Set Cement Plugs • Bottleneck for Cement Jobs • Enlarge Holes for Casing • Enlarge Holes for Gravel Packing • Make Water Shut-Off Tests • Do Fishing Jobs • Straighten Crooked Holes . . . and a lot of other mighty important jobs in an oil well.

Say, I almost forgot to tell you about one thing and that is why they now call me "Two Tools In One." You see, by merely substituting Wall SAMPLER Blades (with small core taking tubes) for my regular Wall SCRAPER Blades, converts me into a Baker Wall SAMPLER . . . and then I can take actual samples of the formation from the side walls of any previously drilled hole.

Well, I'm just about talked out, but if you'd like to have some more information, let me give you a tip . . . my boss has just completed a *New 40 page treatise* (called the Baker Broadcast No. 19) which covers all my important uses and applications. It's a real education and a copy is yours for the askin'.

See You Later,

Baker R. Wall Scraper



BAKER OIL TOOLS, INC.

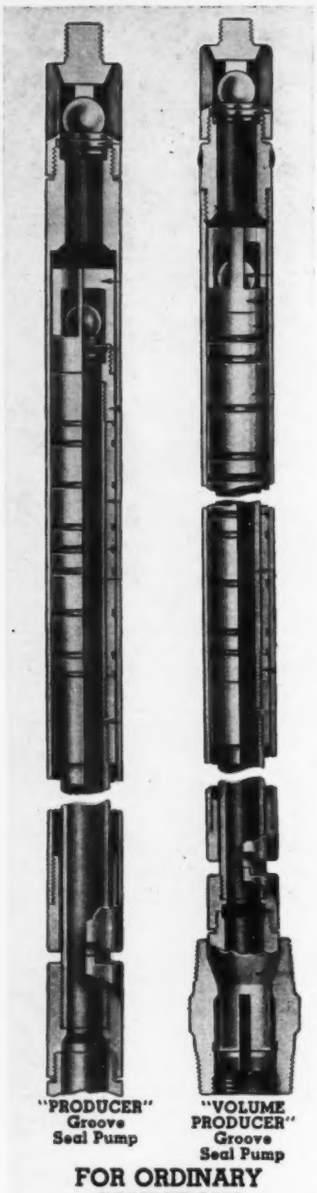
MID-CONTINENT OFFICE AND WAREHOUSE

BAKER ROTARY WALL SCRAPER

ENERGY REQUIRED TO LIFT FLUID, THOUSAND FT.-LB. PER 42-GAL. BBL.

Height of lift, ft.	Sp. gr. of fluid heavier than water				Fresh water (sp. gr. = 1) (A.P.I. gr. = 10)	Gravity of fluid lighter than water, deg. A.P.I.									
	1.16	1.12	1.08	1.04		12	16	20	24	28	32	36	40	44	48
100	40.6	39.2	37.8	36.4	35.0	34.5	33.6	32.7	31.9	31.1	30.3	29.6	28.9	28.2	27.6
200	81.1	78.3	75.5	72.7	69.9	69.1	67.2	65.4	63.7	62.1	60.6	59.2	57.8	56.5	55.2
300	121.7	117.5	113.3	109.1	104.9	103.6	100.8	98.1	95.6	93.2	90.9	88.7	86.7	84.7	82.8
400	162.2	156.7	151.1	145.5	139.9	138.1	134.4	130.8	127.5	124.3	121.2	118.3	115.6	112.9	110.4
500	202.8	195.8	188.8	181.8	174.8	172.7	168.0	163.5	159.3	155.3	151.5	147.9	144.5	141.2	138.0
600	243.4	235.0	226.6	218.2	209.8	207.2	201.6	196.2	191.2	186.4	181.8	177.5	173.4	169.4	165.6
700	283.9	274.1	264.4	254.6	244.8	241.7	235.2	228.9	223.0	217.4	212.1	207.1	202.3	197.6	193.2
800	324.5	313.3	302.1	290.9	279.7	276.2	268.7	261.6	254.9	248.5	242.4	236.7	231.2	225.9	220.8
900	365.1	352.5	339.9	327.3	314.7	310.8	302.3	294.3	286.8	279.6	272.7	266.2	260.1	254.1	248.4
1000	405.6	391.6	377.6	363.7	349.7	345.3	335.9	327.0	318.6	310.6	303.0	295.8	289.0	282.3	276.0
1100	446.2	430.8	415.4	400.0	384.6	379.8	369.5	359.7	350.5	341.7	333.3	325.4	317.9	310.6	303.6
1200	486.7	470.0	453.2	436.4	419.6	414.4	403.1	392.4	382.4	372.8	363.6	355.0	346.8	338.8	331.2
1300	527.3	509.1	490.9	472.8	454.6	448.9	436.7	425.2	414.2	403.8	393.9	384.6	375.6	367.0	358.8
1400	567.9	548.3	528.7	509.1	489.6	483.4	470.3	457.9	446.1	434.9	424.2	414.2	404.5	395.3	386.4
1500	608.4	587.5	566.5	545.5	524.5	518.0	503.9	490.6	477.9	465.9	454.5	443.7	433.4	423.5	414.0
1600	649.0	626.6	604.2	581.9	559.5	552.5	537.5	523.3	509.8	497.0	484.8	473.3	462.3	451.7	441.6
1700	689.6	665.8	642.0	618.2	594.5	587.0	571.1	556.0	541.7	528.1	515.2	502.9	491.2	480.0	469.2
1800	730.1	705.0	679.8	654.6	629.4	621.6	604.7	588.7	573.5	559.1	545.5	532.5	520.1	508.2	496.8
1900	770.7	744.1	717.5	691.0	664.4	656.1	638.3	621.4	605.4	590.2	575.8	562.1	549.0	536.4	524.4
2000	811.2	783.3	755.3	727.3	699.4	690.6	671.9	654.1	637.3	621.3	606.1	591.7	577.9	564.7	552.0
2100	851.8	822.4	793.1	763.7	734.3	725.2	705.5	686.8	669.1	652.3	636.4	621.2	606.8	592.9	579.6
2200	892.4	861.6	830.8	800.1	769.3	759.7	739.0	719.5	701.0	683.4	666.7	650.8	635.7	621.1	607.2
2300	932.9	900.8	868.6	836.4	804.3	794.2	772.6	752.2	732.8	714.4	697.0	680.4	664.6	649.4	634.8
2400	973.5	939.9	906.4	872.8	839.2	828.7	806.2	784.9	764.7	745.5	727.3	710.0	693.5	677.6	662.4
2500	1014.0	979.1	944.1	909.2	874.2	863.3	839.8	817.6	796.6	776.6	757.6	739.6	722.4	705.8	690.0
2600	1054.6	1018.3	981.9	945.5	909.2	897.8	873.4	850.3	828.4	807.6	787.9	769.2	751.3	734.1	717.7
2700	1095.2	1057.4	1019.7	981.9	944.1	932.3	907.0	883.0	860.3	838.7	818.2	798.7	780.2	762.3	745.3
2800	1135.7	1096.6	1057.4	1018.2	979.1	966.9	940.6	915.7	892.2	869.8	848.5	828.3	809.1	790.5	772.9
2900	1176.3	1135.8	1095.2	1054.6	1014.1	1001.4	974.2	948.4	924.0	900.8	878.8	857.9	838.0	818.8	800.5
3000	1216.9	1174.9	1133.0	1091.0	1049.0	1035.9	1007.8	981.1	955.9	931.9	909.1	887.5	866.9	847.0	828.1
3100	1257.4	1214.1	1170.7	1127.3	1084.0	1070.5	1041.4	1013.8	987.8	963.0	939.4	917.1	895.8	875.2	855.7
3200	1298.0	1253.2	1208.5	1163.7	1119.0	1105.0	1075.0	1046.5	1019.6	994.0	969.7	946.7	924.7	903.5	883.3
3300	1338.5	1292.4	1246.2	1200.1	1153.9	1139.5	1108.6	1079.2	1051.5	1025.1	1000.0	976.2	953.6	931.7	810.9
3400	1379.1	1331.6	1284.0	1236.4	1188.9	1174.1	1142.2	1111.9	1083.3	1056.1	1030.3	1005.8	982.5	959.9	938.5
3500	1419.7	1370.7	1321.8	1272.8	1223.9	1208.6	1175.8	1144.6	1115.2	1087.2	1060.6	1035.4	1011.4	988.2	966.1
3600	1460.2	1409.9	1359.5	1309.2	1258.8	1243.1	1209.3	1177.3	1147.1	1118.3	1090.9	1065.0	1040.3	1016.4	993.7
3700	1500.8	1449.1	1397.3	1345.5	1293.8	1277.6	1242.9	1210.0	1178.9	1149.3	1121.2	1094.6	1069.2	1044.6	1021.3
3800	1541.4	1488.2	1435.1	1381.9	1328.8	1312.2	1276.5	1242.8	1210.8	1180.4	1151.5	1124.2	1098.0	1072.9	1048.9
3900	1581.9	1527.4	1472.8	1418.3	1363.8	1346.7	1310.1	1275.5	1242.7	1211.5	1181.8	1153.7	1126.9	1101.1	1076.5
4000	1622.5	1566.6	1510.6	1454.6	1398.7	1381.2	1343.7	1308.2	1274.5	1242.5	1212.1	1183.3	1155.8	1129.3	1104.1
4100	1663.0	1605.7	1548.4	1491.0	1433.7	1415.8	1377.3	1340.9	1306.4	1273.6	1242.4	1212.9	1184.7	1157.6	1131.7
4200	1703.6	1644.9	1586.1	1527.4	1468.7	1450.3	1410.9	1373.6	1338.2	1304.6	1272.7	1242.5	1213.6	1185.8	1159.3
4300	1744.2	1684.1	1623.9	1563.7	1503.6	1484.8	1444.5	1406.3	1370.1	1335.7	1303.0	1272.1	1242.5	1214.0	1186.9
4400	1784.7	1723.2	1661.7	1600.1	1538.6	1519.4	1478.1	1439.0	1402.0	1366.8	1333.3	1301.7	1271.4	1242.3	1214.5
4500	1825.3	1762.4	1699.4	1636.5	1573.6	1553.9	1511.7	1471.7	1433.8	1397.8	1363.6	1331.2	1300.3	1270.5	1242.1
4600	1865.9	1801.5	1737.2	1672.8	1608.5	1588.4	1545.3	1504.4	1465.7	1428.9	1393.9	1360.8	1329.2	1298.7	1269.7
4700	1906.4	1840.7	1775.0	1709.2	1643.5	1623.0	1578.9	1537.1	1497.6	1460.0	1424.2	1390.4	1358.1	1327.0	1297.3
4800	1947.0	1879.9	1812.7	1745.6	1678.5	1657.5	1612.5	1569.8	1529.4	1491.0	1454.5	1420.0	1387.0	1355.2	1324.9
4900	1987.5	1919.0	1850.5	1781.9	1713.4	1692.0	1646.1	1602.5	1561.3	1522.1	1484.8	1449.6	1415.9	1383.4	1352.5
5000	2028.1	1958.2	1888.2	1818.3	1748.4	1726.6	1679.6	1635.2	1593.2	1553.2	1515.2	1479.2	1444.8	1411.6	1380.1

Choose The Pump That Meets Your Particular Needs



"PRODUCER" Groove Seal Pump

"VOLUME PRODUCER" Groove Seal Pump

FOR ORDINARY CONDITIONS

PRECISION BUILT of LONG-WEARING MATERIALS, THESE PUMPS WILL HELP YOU SOLVE YOUR PUMPING PROBLEMS.

●

"PETROL A" Groove Seal Pump

"MARGINAL" Fluid Packed Pump

"POSITIVE PULL" TYPE

"REMOVABLE TYPE"

"RIGID TYPE"

FOR STRIPPER WELLS

These Are The FLUID PACKED PUMPS You Know So Well

GROOVE SEAL TYPE PUMPS

"PRODUCER" Insert (Rod) type pump for wells of medium depth and volume. Long, Efficient service is insured by precision fits and plungers made of durable "Service" or "Supreme" Alloys. Conforms to A.P.I. specifications.

"VOLUME PRODUCER" Used in large volume wells. Has maximum cross-sectional displacement area possible in Insert (Rod) type design. A precision pump with long-wearing plungers of "Service" or "Supreme" alloys. Conforms to A.P.I. specifications.

"PETROL A" This exceptionally low-priced precision pump is specially designed for stripper wells where both initial and operating costs must be kept at the minimum. One-piece plunger makes pump easy to handle in the field and makes fewer parts to stock.

FLUID PACKED PUMPS

The Fluid Packed Pump has demonstrated its efficiency in a great many oil fields of the world, pumping wells with a wide range of depths and gravity. Their ability to handle large quantities of sand without freezing and with minimum abrasion, has for years made them first choice wherever severe service conditions prevail.

"MARGINAL" This new little Fluid Packed Pump solves the problems of profitably producing stripper wells where troublesome sand conditions prevail. Embodies the same successful principle as the larger Fluid Packed Pumps, with the same precision of manufacture and high quality of materials—at a new low price.

"POSITIVE PULL" means ***positive pulling action.*** Recommended wherever the insert feature is desired.

"REMOVABLE" has the manually operated hook-on feature that enables the operator to remove the standing valve and standing tube, or to leave them in place, when pulling the traveling tube.

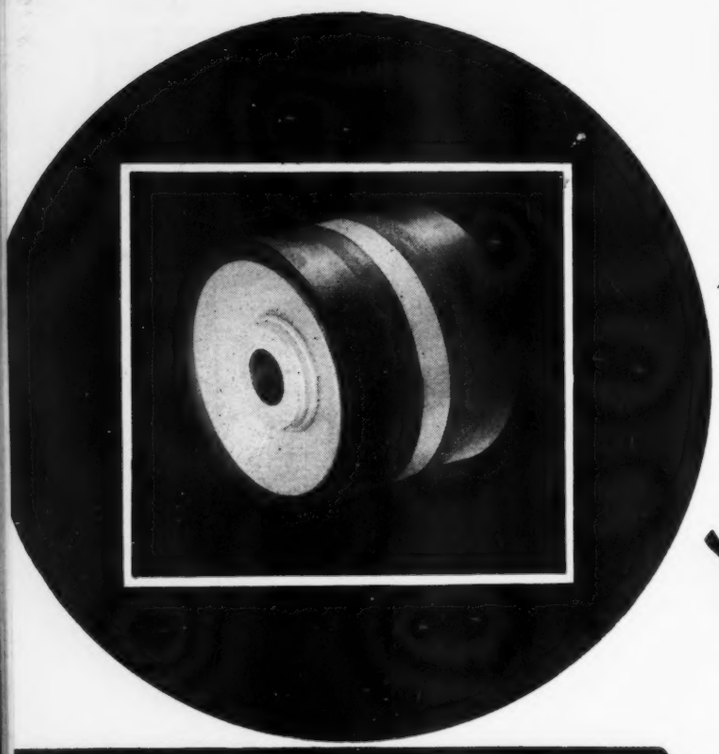
"RIGID" Used where extreme sand conditions or highly viscous oils require most secure anchoring of standing valve.

FLUID PACKED PUMP COMPANY

THEORETICAL CAPACITY OF RECIPROCATING PUMPS, GAL. PER MIN. PER CYLINDER

Displacement, gal. per stroke per cylinder[1]	Pumping speed, strokes[2] (revolutions) per min.										
	18	20	22	24	26	28	30	35	40	45	50
5.20	93.6	104.0	114.4	124.8	135.2	145.6	156	182	208	234	260
5.40	97.2	108.0	118.8	129.6	140.4	151.2	162	189	216	243	270
5.60	100.8	112.0	123.2	134.4	145.6	156.8	168	196	224	252	280
5.80	104.4	116.0	127.6	139.2	150.8	162.4	174	203	232	261	290
6.00	108.0	120.0	132.0	144.0	156.0	168.0	180	210	240	270	300
6.20	111.6	124.0	136.4	148.8	161.2	173.6	186	217	248	279	310
6.40	115.2	128.0	140.8	153.6	166.4	179.2	192	224	256	288	320
6.60	118.8	132.0	145.2	158.4	171.6	184.8	198	231	264	297	330
6.80	122.4	136.0	149.6	163.2	176.8	190.4	204	238	272	306	340
7.00	126.0	140.0	154.0	168.0	182.0	196.0	210	245	280	315	350
7.20	129.6	144.0	158.4	172.8	187.2	201.6	216	252	288	324	360
7.40	133.2	148.0	162.8	177.6	192.4	207.2	222	259	296	333	370
7.60	136.8	152.0	167.2	182.4	197.6	212.8	228	266	304	342	380
7.80	140.4	156.0	171.6	187.2	202.8	218.4	234	273	312	351	390
8.00	144.0	160.0	176.0	192.0	208.0	224.0	240	280	320	360	400
8.20	147.6	164.0	180.4	196.8	213.2	229.6	246	287	328	369	410
8.40	151.2	168.0	184.8	201.6	218.4	235.2	252	294	336	378	420
8.60	154.8	172.0	189.2	206.4	223.6	240.8	258	301	344	387	430
8.80	158.4	176.0	193.6	211.2	228.8	246.4	264	308	352	396	440
9.00	162.0	180.0	198.0	216.0	234.0	252.0	270	315	360	405	450
9.20	165.6	184.0	202.4	220.8	239.2	257.6	276	322	368	414	460
9.40	169.2	188.0	206.8	225.6	244.4	263.2	282	329	376	423	470
9.60	172.8	192.0	211.2	230.4	249.6	268.8	288	336	384	432	480
9.80	176.4	196.0	215.6	235.2	254.8	274.4	294	343	392	441	490
10.00	180.0	200.0	220.0	240.0	260.0	280.0	300	350	400	450	500
12.00	216.0	240.0	264.0	288.0	312.0	336.0	360	420	480	540	600
14.00	252.0	280.0	308.0	336.0	364.0	392.0	420	490	560	630	700
16.00	288.0	320.0	352.0	384.0	416.0	448.0	480	560	640	720	800
18.00	324.0	360.0	396.0	432.0	468.0	504.0	540	630	720	810	900
20.00	360.0	400.0	440.0	480.0	520.0	560.0	600	700	800	900	1000
22.00	396.0	440.0	484.0	528.0	572.0	616.0	660	770	880	990	1100
24.00	432.0	480.0	528.0	576.0	624.0	672.0	720	840	960	1080	1200
26.00	468.0	520.0	572.0	624.0	676.0	728.0	780	910	1040	1170	1300
28.00	504.0	560.0	616.0	672.0	728.0	784.0	840	980	1120	1260	1400
30.00	540.0	600.0	660.0	720.0	780.0	840.0	900	1050	1200	1350	1500
35.00	630.0	700.0	770.0	840.0	910.0	980.0	1050	1225	1400	1575	1750
40.00	720.0	800.0	880.0	960.0	1040.0	1120.0	1200	1400	1600	1800	2000
45.00	810.0	900.0	990.0	1080.0	1170.0	1260.0	1350	1575	1800	2025	2250
50.00	900.0	1000.0	1100.0	1200.0	1300.0	1400.0	1500	1750	2000	2250	2500
60.00	1080.0	1200.0	1320.0	1440.0	1560.0	1680.0	1800	2100	2400	2700	3000
70.00	1260.0	1400.0	1540.0	1680.0	1820.0	1960.0	2100	2450	2800	3150	3500
80.00	1440.0	1600.0	1760.0	1920.0	2080.0	2240.0	2400	2800	3200	3600	4000
90.00	1620.0	1800.0	1980.0	2160.0	2340.0	2520.0	2700	3150	3600	4050	4500
100.00	1800.0	2000.0	2200.0	2400.0	2600.0	2800.0	3000	3500	4000	4500	5000

[1]Table P 094.865, Sheets 1 and 2, pp. 123, 125, July, 1937.
[2]For double-acting pumps make sure that the "displacement" value used is the total for both ends of the pump.



WHY

IMPROVED MISSION SLUSH PUMP PISTONS *Cut* UPKEEP COSTS IN HALF.....

REPLACEABLE RUBBERS in a permanent body

Cuts Reconditioning Costs In Half . . . Cheaper operation . . . Replaceable without removing Piston from Rod . . . Saves time . . . Saves Liners.

DROP FORGED CHROME NICKEL BODY . . . One piece construction

Pistons Last Longer . . . Resists any pressure . . . Permits safe use on Tapered Rod, thereby positively eliminating rod cut-outs, saving rod costs . . . Can be reworked economically . . . Eliminates danger of wrecking pump.

LIGHTEST WEIGHT PISTON ON THE MARKET

Reduces Liner and Rod Wear . . . Reduces packing costs . . . Saves packing time.

GREATER WIPING SURFACE

Pistons Last Longer . . . Liners last longer . . . Faster drilling . . . More fluid per hour.

CAREFUL INSPECTION

Insurance Against Misfits . . . Saves shut-down time . . . No lost time in installation . . . Longer piston life.

SAVING MONEY
for SUCCESSFUL OPERATORS
the WORLD OVER

Sold through supply stores everywhere

MISSION MANUFACTURING CO.

HUMBLE ROAD - - - - - - HOUSTON, TEXAS

MISSION SLIPS - MISSION VALVES - MISSION PISTONS - MISSION PISTON RODS - MISSION SWABS
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